ADHESIVES AGE

MANUFACTURE, APPLICATION, TECHNOLOGY, RESEARCH AND MARKETING OF ADHESIVES

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Adhesion Problems on the Production Line

* * *

Compounding Polyvinyl Acetate Adhesives

* * *

Fish Glue — A By-Product of Nature

DECEMBER, 1958

News about R&A SINCE 1913 **Adhesives**

FOR ALL METALS AND ALL PLASTICS

New "room temp" curing epoxy adhesive spreads like cold cream

TECHNICAL DATA ON

Bond*master*® M688

A thixotropic, room temperature curing, 100% reactive, two-component, solvent-free modified epoxy adhesive designed for bonding metals and rigid plastics as well as other rigid materials to themselves and to each other.

APPLICATION

Mixed BONDMASTER M688 is soft and buttery, making it extremely easy to spread smoothly and evenly. Once applied, it maintains its form and DOES NOT FLOW during the curing cycle. Excellent for "poor fit" and similar void-filling applications as well as where dripping or running of adhesive cannot be tolerated.

CURE

Bonded assemblies which have been cured at room temperature can be handled in 4 to 6 hours and develop 85% of their maximum strength in 14 to 24 hours. Alternately, where practical, any of the following heat-cure cycles may be used to achieve full strength more rapidly: 100°F for 2 hours; or 150°F for 30 minutes; or 200°F for 15 minutes; or 250°F for 10 minutes. See Technical Data Sheet for alternate hardeners, pot life, cure cycles, etc.

BOND CHARACTERISTICS

Fully cured bonds exhibit minimal shrinkage, are electrical insulators, and provide excellent resistance to weather, galvanic action, and most chemicals, acids, and alkalies.

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Here is why you can save valuable application time as well as material costs with this 100%-reactive, solvent-free epoxy adhesive, BONDMASTER M688:

- Smoothly, easily spreadable with trowel, spatula, knife edge, etc.
- Non-sag (thixotropic) in any position . . . even while curing. Eliminates costly cleanup.
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- 100%-reactive . . . no waiting for solvent evaporation . . . mere contact pressure is sufficient.
- Solvent-free . . . no danger of attack on soluble thermoplastics (cells of foamed polystyrene, for example).

ALL METALS—ALMOST ALL PLASTICS

You'll get strong (in excess of 2,000 psi tensile shear on aluminum-to-aluminum, for example) bonds with cast iron, steel, stainless, magnesium, aluminum, copper, brass, bronze . . . *any* metal . . . to themselves or to just about *any* plastic—rigid, foamed, or flexible.

And, of course, to glass, ceramics, wood, and structural laminates based on reinforced melamine, polyester, phenolic, epoxy, etc., resins.

WRITE FOR FURTHER DATA

Write for detailed Technical Data Sheet today. We'll be glad to send a free sample as well if you will describe your bonding problem in detail.

Enjay Butyl window-sealing tape was employed throughout the newly erected Industrial Reactor Laboratories in Plainsboro, N. J. Architect: Skidmore, Owings & Merrill

ENJAY BUTYL

caulking prevents leakage in new Atomic Reactor Lab

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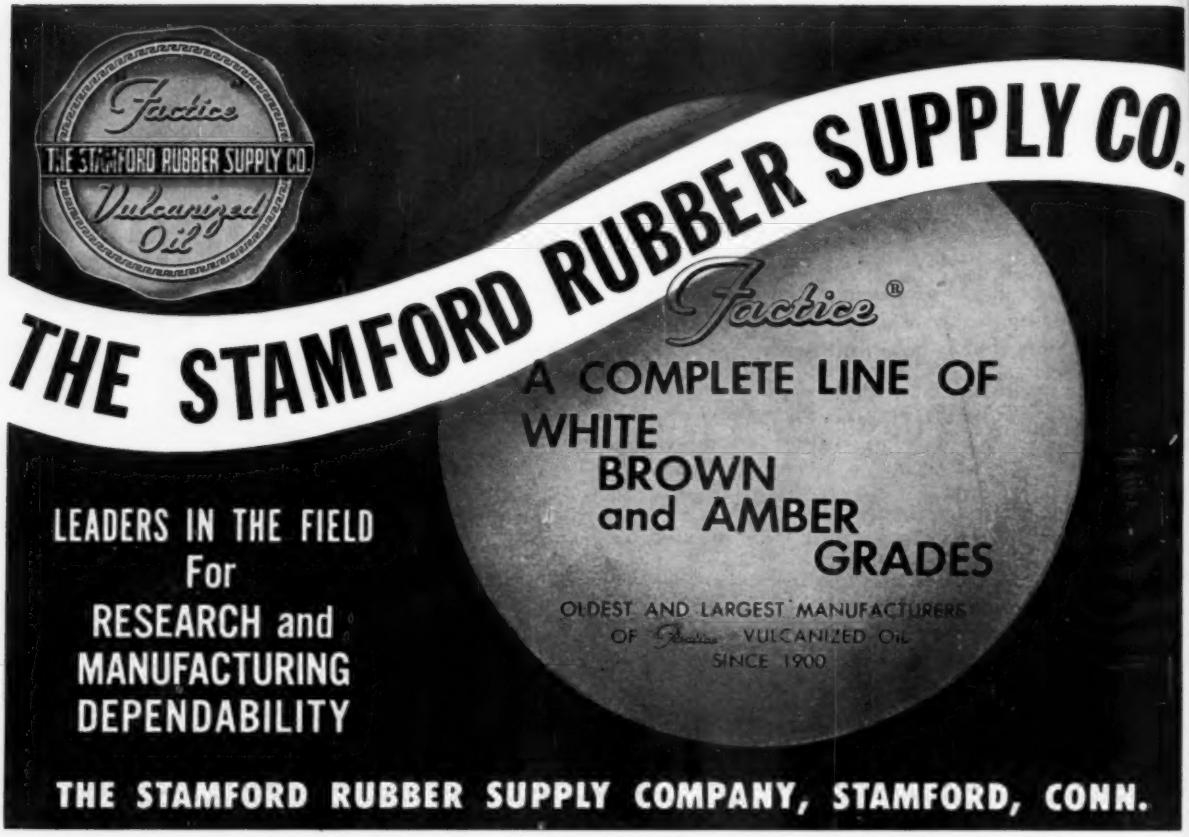

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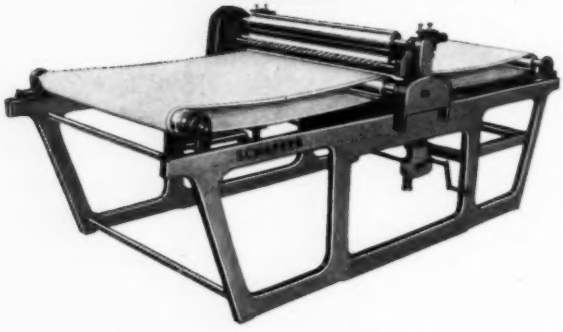

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EDITORIAL

Communication is the essence of the printed word and communication is the function of a business paper. We here at ADHESIVES AGE, working in a relatively new industry, must communicate with our readers on various levels. On one level our function is to report accurately the news happenings of the day. On still another level we should impart to the adhesives industry a working knowledge of new technological developments. On still a third level, we reflect the opinions and desires of the readers.

In working with the first level, we make it a point to inform ourselves of all news developments in the field and pass them along in a concise and readable fashion. To do this we employ an able staff of editors and correspondents who report to us those pertinent occurrences which warrant publication.

On the second level, we make an effort to obtain articles which are most revealing of technical developments so that our readers can keep abreast of the situation.

It is on the third level that this matter of communication becomes a two-way street. Obviously, a limited staff can not be all places at once. It, therefore, behooves the individual reader and the individual company to keep the adhesives industry as a whole advised of their activities. When a company introduces a new product, or when a company shifts its personnel, this is news and should be reported as such. When the individual reader or company reports facts such as these to us we are in a position to provide maximum publicity to these events. In addition, we are able to determine trends, or even certain shortcomings in the industry.

The publication of a wide variety of news and reports from individuals and companies enables us to present a rounded picture of the adhesives field. This certainly works to a mutual advantage. It is urged, then, that all members of the adhesives industry submit to our editors news of developments, new products, the acquisition of new properties, of personnel realignment, of current plans, etc. With this constant flow of information we shall be able to better serve the adhesives industry.

• • •

At this holiday season we extend to our new and valued friends in the adhesives industry our wishes for a healthy, peaceful and prosperous year. A Merry Christmas to us all!

Arch Doria

EDITOR

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CONSULTANT'S CORNER

By Dr. Irving Skeist

Adhesives for Plastics

Question: "As a technical representative I am requested to offer suggestions on adhesives application to a wide variety of plastic surfaces. I would like to be able to recommend raw materials or combinations of raw materials that will work. Basically, what I need is a list of resins and how they are used in adhesives as well as information on the surfaces to which they adhere. I do not mind recommending finished adhesives and often do, but for my own information I would rather have basic information. If you can help this weak spot in my technical knowledge, I would appreciate it."

Answer: There are two broad classifications of plastics: the thermoplastics and the thermosets. The thermoplastics are materials which soften when heated and harden when cooled, like butter or wax. Among the more important thermoplastics are polyethylene, vinyls, polystyrene, cellulosics, acrylics. The thermosets are materials which cure or harden irreversibly when heated, like an egg. This group includes the phenolics, ureas, melamines, polyesters and epoxies. If we could magnify a million times, we would see the molecules of thermoplastic as little threads, each a separate entity; but in the thermoset resin, each thread would be knotted to many others to make one big ball of molecule.

Thermoplastics: Some thermoplastics can be sealed without adhesive, by heat alone. This is the manner in which polyethylene is bonded to itself to make protective transparent bags for produce and soft goods. Vinyl film is sealed by dielectric heat in the manufacture of raincoats and beach equipment. Both polyethylene and vinyl pipe can be heat-welded, by inserting a heated metal plate between two sections of pipe until the plastic becomes molten, then withdrawing the plate and forcing the two ends together.

Polyethylene, especially, has been difficult to bond with adhesives, as it is a crystalline plastic which is not attacked by solvents at room temperature. Two methods have been evolved to answer the problem. First, the surface can be oxidized by a flame treatment or with an oxidizing chemical such as chromic acid. Second, Bell Laboratories scientists have found that partially hydrogenated polybutadiene will bond polyethylene to a variety of other materials, including rubbers and brass.

Vinyl sheeting is laminated to plaster walls, metals, Mylar and other sheets and films with the aid of solvent adhesives containing vinyl resins, along with nitrile rubbers and other ingredients. Here we see the application of several principles:

(1) The adhesive should be similar in polarity to the adherend. Adhesives which are close to adherends in "solubility parameter" have the best chance of wetting them. The vinyl chloride resin in the bondant almost

CONSULTANT'S CORNER

identical, chemically, with the vinyl resin in the plastic film; and the nitrile rubber, while chemically quite different, has nearly the same solubility parameter.

(2) It is often advisable to make the adhesive flexible, so that stresses will accumulate elsewhere than in the adhesive layer when the laminate is distorted. In this case, the nitrile rubber is the flexibilizing component.

(3) Plasticizer migration is a problem which can be minimized or avoided altogether by proper formulation. Vinyl resins must be combined with plasticizers for flexibility. But some of the most widely used plasticizers, for example DOP (dioctyl phthalate), may travel from the adhesive layer to one of the adherends, leaving the adhesive layer shrunken and brittle. This was a defect of some of the early pressure-sensitive vinyl wall coverings. To overcome plasticizer migration, the formulator shifts to polyester polymeric plasticizers, or to nitrile rubbers.

(4) The adhesive must wet the adherends. This means that the adhesive must at some stage have a low viscosity. The vinyl adhesives accomplish this through the use of solvents.

(5) If neither adherend is porous, the solvent will not be able to escape; consequently it may be necessary to wet one or both surfaces, allow the solvent to evaporate, and then bring the tacky surfaces together.

Polystyrene, polymethyl methacrylate (acrylics), and cellulosic plastics are also bonded with solvent cements. The adhesive may consist entirely of solvents, or it may be "bodied" with a few per cent of polymer. Usually, the polymer is similar in composition to the plastic being bonded. The cellulosics, however, are sometimes bonded with nitrocellulose cement.

The solvents vary with the plastic. For each plastic, low-boiling solvents give the best tack and permit fastest production; but they can also cause *crazing* of polystyrene or acrylic. On the other hand, high-boiling solvents and plasticizers are generally too slow-acting to be feasible by themselves as room-temperature adhesives. In between are the medium-boiling solvents of greatest utility for bonding.

Thermosets: The thermosets are not softened by solvents; a different approach is required. Generally, the most suitable adhesives are themselves thermosetting resins, applied to the plastics in solution form or as 100% liquid intermediates.

The epoxy resins, either by themselves or in conjunction with phenolics, are adaptable to many plastics bonding needs. The liquid epoxies have excellent wetting power, bonding well to phenolics, polyesters and amino resins as well as cured epoxies. Since there is no solvent to get rid of, the epoxies are employed for bonding plastics to themselves or to other impervious materials. Shrinkage is low. Flexibility can be built into the adhesive by compounding the epoxy with suitable amine, polyamide or polysulfide plasticizers. Polyester canoes and phenolic printed circuits are among the plastic items that have been bonded with epoxies.

A different example of the mating of thermosetting resins is provided by the decorative laminated table tops which have become so familiar by one of their trade names. These have a center core of amber phenolic, but the visible outer layers are of decorative paper impregnated with light-colored melamine. Adhesion between the two resins is excellent.

Dr. Skeist, visiting professor of Physical Chemistry of Polymers at Stevens Institute of Technology, is associated with Skeist & Schwarz Laboratories, Inc. of Newark, N. J.

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new adhesives

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Puncture Sealing Powder

A rubber powder is now available which makes any tubeless passenger tire puncture sealing. Tires containing 2½ ounces of Air Guard can be driven for more than 48 hours after being punctured, even if the tire has not retained the puncturing item. The powder, said to seal punctures up to ⅛ of an inch, does not affect the repairability

of the tire nor in any way change the balance or performance. It retains its sealing efficiency during tire life, or until it is removed. It works with tubeless tires only.

After a puncture is repaired, an additional 2½ ounces of Air Guard should be introduced into the tire. While this operation is simple, it should be performed by a service man. One bead of the deflated tire is pushed away from the rim flange just enough to allow introduction of the powder. The tire is then reinflated to the correct pressure. *United States Ruber Co.* P-23

Patching Compound

H-F Epoxy-Crete, a newly developed surfacing and patching compound, consists of epoxy resin plastic, a hardening agent and kiln-dried sand. Blended, the mixture bonds permanently to old or new concrete, wood or metal floors, forming a firm, smooth surface that is resistant to heavy impact, abrasion and chemical action. The compound is not affected by scrubbing with strong alkali soaps or detergents. Hardening takes place within 12 to 24 hours, and is said to result in a tensile strength much higher than concrete. The surface is highly skid-resistant. A companion product, H-F Epoxy-Tred, contains a special abrasive that forms a permanently non-skid surface on areas where hazardous footing is a problem. *Howe & French, Inc.* P-24

Film Form Adhesives

Plymaster V-2 and Plymaster V-3 are dry, 100 per cent reactive synthetic rubber-resin adhesives in film form for use in a variety of flat-surface bonding operations. V-2 consists of a porous glass fiber mat which has been impregnated with a liquid adhesive to achieve a dry, latent adhesive film that is internally reinforced for additional cohesive strength. Nominal thickness is approximately 11 mils, adhesive pick-up about five ounces per square yard, and the weight is approximately six ounces per square yard.

V-3 uses a high strength porous paper as the carrier and offers a thinner film suitable for applications requiring slightly lower strength. Nominal thickness is about four mils, adhesive pick-up approximately two ounces per square yard and the weight about 2.5 ounces per square yard. Both V-2 and V-3 are 36 inches wide, come in 100-yard rolls, and have a shelf life of about six months from the date of manufacture. *Rubber & Asbestos Corp.* P-25

Dry Mix Additive

A spray dried polyvinyl acetate resin recently introduced can be used in place of liquid vinyl emulsions wherever the presence of water is undesirable. Darex ESD (experimental spray dried) is expected to find wide use as an additive in dry mixes of specialty portland cements, as a vehicle for industrial paints, and as an adhesives base. Easily reconstituted by adding water,it can be stored indefinitely, is unaffected by freezing, and can be mixed as needed where small batches are prepared at a time. *Dewey and Almy Chemical Div., W. R. Grace & Co.* P-26

Ribbon Pipe Dope

Pipe joint sealing with Ribbon Dope, rather than liquid or semi-liquid varieties, eliminates spillage, shrinkage, evaporation and the need for brushes. Available in dispenser rolls of 260 and 520 inches, Ribbon Dope protects pipe joints against the corrosive action of virtually all known chemicals and gases. Unaffected by weathering or extended aging, it can be used on pipes subjected to temperatures ranging from −250° F. to 500° F. *Permacel, Inc.* P-27

Adhesive for Ceramics

Ceramic tile can be adhered to virtually any surface with Dex-O-Tex BC-100, a neoprene composition adhesive. The product is supplied in two components which are mixed at the time of application: BC-100 Paste, a liquid neoprene; and BC-100 Powder, a dehydrating and setting powder. The high percentage of neoprene latex in the mixture forms a flexible rubber-like bond which reduces or eliminates tile cracking in installations subject to considerable movement. Retention of a perfect bond under sustained water immersion conditions makes Dex-O-Tex suitable for tiling swimming pools. The adhesive's advantages in exterior installations are listed as extreme resistance to freezing, thawing, oxidation and ozone attack. It will adhere tile to surfaces such as concrete, cinder block, brick, masonite, asbestos board, plywood, steel, aluminum existing ceramic tile or glass. *Crossfield Products Corp.* P-28

Veneer Bondants

Veneer bonding operations are said to be facilitated by two improved adhesive resins recently introduced. Melurac (R) No. 260 is designed to provide faster curing than the 259 formulation it replaces. The melamine-fortified urea resin, with catalyst incorporated, is used in the standard manner except that because of faster curling, lower temperatures are recommended for splicer bars. This minimizes the possibilities of scorching and discoloring light-colored woods. No additive other than water is required. The faint tan color of the product makes the glue line almost invisible.

Melurac (R) No. 305, a filled melamine-urea adhesive in dry powder form, is more waterproof than the Melurac No. 300 it replaces, and will produce better adhesive bonds with hard-to-glue woods. *American Cyanamid Co.* P-29

Synthetic Film Bondant

A recently introduced pressure-sensitive thermoplastic adhesive known as A-916-B bonds new synthetic films to metals, paper, wood, glass, plaster and other materials without heat or special surface treatment. No additional resin or other tackifier is required. Though basically a virtually colorless transparent material, A-916-B can be furnished in any color. A minimum of volatiles in the highly concentrated 50 per cent solids solution makes a little go a long way. Features of the material include excellent storage stability and retention of adhesive and cohesive properties indefinitely, either in storage or service, in or out of solvent. Application can be made by brush, roller, knife or spray. *B. F. Goodrich Industrial Products Co.* P-30

Odorless Adhesives

Foylam adhesives for bonding aluminum foil to paper and board stocks, are said to eliminate adhesive odors from metallic wrap without sacrifice of water and heat resistance. They are based on the polymerization and compounding of a synthetic resin emulsion having resistance properties formerly attainable only with adhesives compounded from synthetic rubber latices. Usable on all existing laminators, Foylam has proved satisfactory on aluminum foils from 0.35 to 2.5 mils in thickness, on natural kraft and glassine papers. It is available in various ranges of viscosity and solids-content, depending on machine specifications and type of paper or paperboard substrate.

The adhesive is characterized by a low dry coating weight (0.4 to 0.7 dry pounds per 1000 sq. ft.) and excellent machinery stability. It eliminates foaming problems and its wet shelf stability permits at least 120 days of storage under normal conditions. *Morningstar-Paisley, Inc.* P-31

Phenolic Liquid Adhesive

EC-1471 is a modified phenolic liquid adhesive used to bond metal facings to honeycomb core material, to produce honeycomb structures, and to bond metal-to-metal panels. High strength properties are maintained over a service temperature range of —65° to 180°F. Curing for 45 minutes at 350°F. under a pressure of 50 to 200 psi will achieve a bond with room temperature shear strength of 5300 psi. Longer cures produce high elevated temperature strength properties. EC-1471 can be supplied as a glass fabric supported film on special request. *Adhesives, Coatings and Sealers Division, Minnesota Mining & Mfg. Co.* P-32

Bookbinding Adhesive

Perfex, a cold bonding water-base adhesive which is said to provide a strong bond within five seconds of application, eliminates the use of staples even on coated stock. Quick grab prevents covers from shifting between time of contact with the adhesive and folding. Product requires no heating and does not become brittle or crack with age. *Adhesive Products Corp.* P-33

Water-Based Contact Cement

Designed for bonding plastic laminates and installing plywood wall panels, Elmer's Contact Cement Non-Flammable also bonds dissimilar materials. This water-based product can be easily washed off hands and equipment with warm, soapy water. It can be used without thinning. Because it bonds instantly on contact, no clamping is necessary. *Borden Chemical Co.* P-34

Curtain Wall Sealers

Exterior and interior joints and openings between curtain wall panels and the metal framework of buildings can be sealed with Weatherban, a new series of synthetic rubber base products developed for this purpose. When mixed with a curing agent these liquid two-part sealers chemically cure in place to produce a solid rubber seal which possesses excellent flexibility, durable aging qualities, and excellent adhesion to common building materials. Their resilience and elastic properties enable them to absorb the substantial movement of curtain wall panels or glass in the frame. These liquid sealers are available in black, tan and aluminum colors and have a respective tensile strength of 200, 110 and 80 psi. Sealer is flowed into place by means of a hand caulking gun or pressure activated flow gun. *Adhesives, Coatings and Sealers Division, Minnesota Mining & Mfg. Co.* P-35

Plastic Metal Kit

A new five-in-one plastic metal kit announced contains one pint of clear Flawmaster epoxy and five jars of powdered metals. The powders may be

mixed with the clear epoxy to meet any metallic bonding needs, or the clear epoxy may be used to bond glass, china, plastic, wood, etc. *Carl H. Biggs Co.* P-36

Lump Phenolic Resin

When properly incorporated in neoprene solvent-type cements, SP-126 Resin is said to provide the highest obtainable degree of heat resistance. This oil-soluble, heat-reactive, lump phenolic resin is generally used in quantities of 100 parts per 100 parts of rubber. The adhesive is made either by mixing together solvent, premilled rubber and resin, or by milling the resin in rubber stock before cold-cutting with solvent. Additional features of SP-126 include fast air drying and excellent cohesion and adhesion. *Schenectady Resins Division, Schenectady Varnish Co., Inc.* P-37

FOR MORE INFORMATION on the new adhesives described here, use the Reader's Service Card elsewhere in this issue.

Nacconate 300 Base

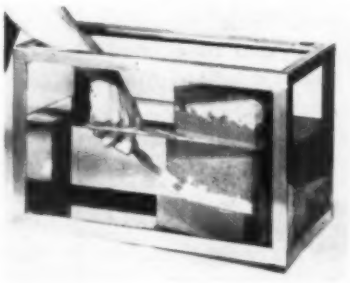
Isocyanate adhesive, prepared from Nacconate 300 and castor oil, is particularly suited for bonding wood, glass, leather, vinyl sheeting, and other materials to themselves and to each other at room temperature and with contact pressure. To prepare the adhesive, 100 grams of Nacconate 300 is melted under a dry atmosphere and 123 grams of commercial, low-moisture grade castor oil added. The mixture is heated at about 60°C. for one hour under dry atmosphere, and the product is aged for 24 hours out of contact with atmospheric moisture. Immediately prior to use, the concentrated adhesive is dissolved in equal amounts of a 50 per cent solution of acetone in toluene containing 0.5 to 1.0 per cent N-methyl morpholine. Both surfaces are brushed with the mixture and an open cure time of 10 to 15 minutes is allowed before the bond is made. *National Aniline Division, Allied Chemical & Dye Corp.* P-38

Silastic Bonding Agent

An easy-spreading, solventless silicone rubber paste, Silastic S-2200 bonds vulcanized Silastic to various metals and to vulcanized Silastic itself. Features of the adhesive include adequate flow under pressure and serviceability at from—70° to 500° F. No additional cure is needed when bonding Silastic to Silastic, or when bondng Silastic to metals primed with A-4094 Primer. Vulcanization requires five minutes at 260° F. A five-mil coating, as measured after vulcanization, is sufficient for good adhesion. *Dow Corning Corp.* P-39

Underwater Paste

Good adhesion can be obtained in completely wet locations with Epocast 546, a new epoxy paste which cures firm and hard in underwater locations.



Application of the paste is in combination with Hardener 9514. The mixture is trowelled or squeegeed into position, and hardens overnight. *Furane Plastics, Inc.* P-40

TECHNOLOGY OF ADHESIVES AT YOUR FINGERTIPS

AA SERVICE

Subscribers to ADHESIVES AGE may now obtain, from one central source, technical literature dealing with all aspects of the adhesives industry. One or more of the books listed here may be of invaluable assistance to you. Look this list over and check the books suited to your needs.

- **Adhesive Bonding of Metals—G. Epstein. $2.95.** Considers adhesives used with metals, indicating when an adhesive-bonded joint is advantageous; the type adhesive to use; how to use it, and how to design the joint for optimum performance. ☐

- **Adhesive Bonding for Fibrous Glass Reinforced Plastics—H. A. Perry. (To be published in January. Probable price, $10.00.)** A theoretical and practical manual on the joining of glass reinforced plastics. ☐

- **Adhesives for Wood—R. A. G. Knight. $5.00.** A guide and reference to the problem of joining components together. Considers components made of wood in one of its many forms and the joining of wood to metals and plastics. ☐

- **Epoxy Resins—Their Applications and Technology—H. Lee and K. Neville. $8.00.** Guide to the field of epoxy resins, covering the chemistry of their preparation and applications, including a section on adhesives. ☐

- **Polyamide Resins—Donald E. Floyd. $4.50.** Discusses in detail various important applications of the polymers belonging to the polyamide resin family and includes a comprehensive section on adhesives. ☐

- **Principles of High Polymer Theory and Practice—A. X. Schmidt and C. A. Marlies. $12.50.** Study of the principles of high-polymer theory and practice, with a section on adhesives; their applications, and mechanisms and factors involved. ☐

- **Recent Advances in Gelatine and Glue Research—G. Stainsby (Editor). $12.00.** Study of Collagen, and its protein gelatine, comprising papers and Proceedings of an International Conference of the British Gelatine and Glue Research Association. ☐

- **Rubber-to-Metal Bonding—S. Buchan. $4.00.** Discusses methods for bonding natural and synthetic rubbers to metals of all kinds, for use by those who manufacture rubber-metal units, and of interest to the rubber-minded engineer. ☐

- **Vinyl Resins—Mayo Smith. $5.75.** Surveys applications of vinyl resins with information on their types, properties, chemistry, manufacture and fabrication. Includes information on several types of adhesives in this category. ☐

- **Adhesion and Adhesives: Fundamentals and Practice—F. Clark, J. E. Rutzler, Jr. and R. L. Savage (Editors). $10.50.** Papers read at a Symposium at Case Institute of Technology and a Conference in London, on the status of knowledge in adhesion. ☐

ADHESIVES AGE
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CORPORATE PROFITS WILL REALLY ZOOM the rest of this year and in '59. Economists expect industry's earnings to move up even faster than they fell during the worst of the recession. (They were down 30% by last January.) By year-end, three quarters of the earnings loss will have been recovered. By next Spring, profits should again top the $46 billion rate of late 1956.

Rising sales are bringing production back to well above the "break-even" point for many lines. Put another way, rising productivity means lower unit costs, bigger profit margins. Some of the biggest gains are coming in the lines that were hardest hit by recession—but this isn't always the case.

Here's the profits outlook, industry by industry:

- Large gains are developing in profits of the railroad, oil, construction materials, aircraft, electrical equipment, and tire makers, textiles, iron and steel, and in automobiles.
- Smaller hikes—though still solid ones—are coming in food, beverages, and tobacco, drugs and cosmetics, transportation equipment, utilities, nonferrous metals, and the chemicals.

THE SECOND PHASE OF THE COUNTRY'S BUSINESS RECOVERY is now beginning. The things that got the upturn started are still supplying plenty of steam. But they've begun to generate secondary effects, reinforcing the first lift.

The first phase of recovery has taken the economy back some 75% of the way to the pre-recession peak. It was prompted by an expansion in home-building, a rise in federal spending, and steady increases in consumer buying. Stock market jumps helped by increasing consumer and business confidence.

The second phase of the upturn will bring business activity to a new record—possibly before 1958 is over. Efforts to rebuild depleted inventories and new interest in expansion ...both powerful stimulators...will be the dynamic factors.

The third phase will come in the Spring of 1959, and usher in a period of new records. Some economists think we may see an all-out boom; others just see steady, solid growth.

DON'T LOOK FOR NEW STEPS TO TIGHTEN CREDIT to be taken soon by the authorities in Washington. But this doesn't mean money won't get tighter. Officials at the Federal Reserve think they have done all that's necessary to keep a rein on the boom. They're ready to let natural forces do the job for a while. These forces include rising need for inventory loans, demand for expansion capital, and the government's borrowing to meet the deficit.

DEMAND FOR ENGINEERS AND TECHNICIANS will soon be on the rise again, say federal personnel experts. Two or three years ago, new graduates had their pick of jobs. But the recession, and cuts in defense spending, cut demand. Now the picture has changed back with the growing missile programs.

capitol cues

A PICK-UP IN U.S. FOREIGN TRADE is under way—another by-product of the business recovery. Other countries let their stocks of U.S. goods run down during the late recession, and now must restock. In addition, they are getting more dollars because—with better times—Americans buy more abroad.

Here's the outlook as government trade specialists see it:
- U.S. exports will rise 3% or 4% in months ahead. Machinery sales will go up 5%, grains 2%, chemicals, 4%, metals, 10%.
- U.S. imports will climb even more—cars, coffee, newsprint.

A SYSTEM FOR INTERCHANGING TRUCK-TRAILERS, recently approved by the Interstate Commerce Commission, promises substantial benefits for shippers—as well as stiffer competition for the railroads. The new program will let truckers exchange trailers the way railroads lend each other freight cars. Shippers will benefit through faster service and less damage in rehandling. The plan is scheduled to go into operation some time in the Spring of 1959.

USE OF ELECTRONIC BRAINS TO CHECK TAX RETURNS and spot more evaders will be started by Internal Revenue Service in 1959—with individual returns of 1958. The first task of the new "electronic data processors" will be to select for more intensive audit those returns that may be out of line in some respect. Then the machines will use "taped-in" standards for testing the reasonableness of itemized personal deductions...travel expenses...large losses or sick pay exclusions...and unusually large numbers of exemptions.

Revenue officials hope to increase the number of individual returns that can be audited annually. Later on, they expect to handle returns of corporations—perhaps by 1960 or 1961.

WHAT WILL THE NEW CONGRESS JUST ELECTED do for...or to ...business? The question was put to Congressional leaders after the votes were tallied. In their opinion, the bigger Democratic majorities foreshadow less sympathy for the business viewpoint on Capital Hill. But the fact that conservative Southerners will still run committees will block ultra-New Deal type laws.

Here's the kind of thing the leaders see ahead—
- On labor, Democrats will work for mild racketeering curbs—to block really tight laws—and a hike in the minimum wage.
- On antitrust, Democrats will push a bill making merging firms notify Justice in advance. A U.S. Fair Trade law will fail.
- On spending, though farm aid and the recession programs will shrink, housing and foreign aid expenditures will increase.
- On taxes, you'll hear much on increases to fight inflation, but conservatives will head off any major readjustments.
- On regulation, there probably won't be any easing of rules governing renegotiation of Federal contracts, while Federal Trade, Federal Communications, etc., may get bigger powers.

And there will be plenty of investigations—on industry's pricing and sales to government, and on inflation's threat.

SMALL FIRMS WILL BE ABLE TO GET ADVICE as well as special financing from the new Small Business Investment Companies which will soon get rolling. The law permits these new financial institutions to provide consultations. They must dig to check on borrowers, and can counsel on problems uncovered.

...to you and you
...from you...you...and you

No Christmas gift is more widespread or important in effect than Christmas Seals. Given by most Americans, they help make possible the greatest gift of all—health, life itself.

Since 1907, the Seals have financed vast anti-tuberculosis activities that have saved more than eight million lives! Yet there will still be about 90,000 new TB cases this year.

So continue to give the gift that saves lives... use Christmas Seals on every letter, card, and package... and be sure to send in your contribution today. ***Buy and use Christmas Seals.***

This space contributed to the National Tuberculosis Association and its affiliates by

ADHESIVES AGE

A guide to the formulation of successful emulsion adhesives

By ALEXANDER A. NICHIPOR

Dewey and Almy Chemical Division
W. R. Grace & Co.
Cambridge, Mass.

► *The following article outlines the broad principles involved in compounding polyvinyl acetate emulsion for adhesive applications. To facilitate an understanding of the concepts to be dealt with, the author first surveys adhesives in general and discusses the significance of their properties. Although it is not possible to present more than a small fraction of the background which exists in the adhesive field, the precepts described here should act as guideposts along the path to the formulation of successful polyvinyl acetate emulsion adhesives.*

Although in the last two or three decades scientific investigation into the theoretical aspects of adhesives has shown steady progress, there is as yet no satisfactory theory which accounts quantitatively for all the phenomena observed. In the final analysis, a trial and error procedure is necessary to work out specific applications. An acquaintance with those qualitative principles developed so far, however, can abbreviate the time necessary to solve any given problem. A short general consideration of the mechanism of adhesion may, therefore, be profitable.

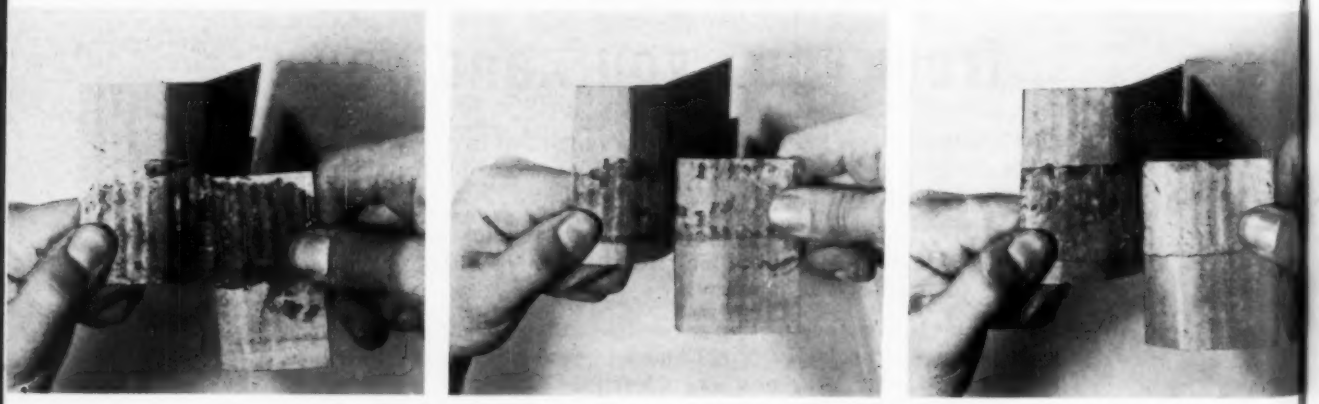
Two surfaces can be joined by either mechanical means such as nails or rivets, or by chemical means such as adhesives. Adhesives depend for their strength upon molecular forces operating between the surface of the article to be glued and the adhesive film, between the surfaces across the adhesive layer, between the surfaces and the interior of the film, or on a combination of all the preceding three.

It is obvious, therefore, that the range of the molecular "attraction" must bridge the film thickness and that the molecules touching the solid surfaces should become oriented so that, through chain effects, the "attraction" influence will be extended through the film and onto the surface to be glued. In addition, the adhesive forces between the bonded surfaces must be greater than the cohesive forces of the molecules of the adhesive film itself or the glued article will fail at the glue line when subjected to stress or strain. With the selection of the proper adhesive, the failure will always be within the structure of the bonded article and not at the bond.

Other important factors in good adhesive performance are the use of clean surfaces and a thin adhesive film. In addition, it is undesirable to wet a porous surface excessively as the adhesive may strike into the surface and an insufficient amount may be left in the joint itself (starved glue line). Enough adhesive must be present to form a continuous film between the bonded surfaces, otherwise the affected area of the joint is reduced.

It has been demonstrated experimentally that as long as the adhesive film is continuous, the thinner the glue line the better the bond. In a thin film, the chemical forces exert the greatest range on the surface to be glued. If the film is thick, the cohesive forces of the molecules of

Compounding Polyvinyl Acetate Adhesives



"Quick grab," that made polyvinyl acetate emulsion adhesives famous, is shown in this series of three photos: In this first picture (left) taken five seconds after application, a case lap adhesive made with polyvinyl acetate emulsion has already formed "legs," indicating that enough water has evaporated and soaked into the corrugated board so adhesion has begun. Small section at right already shows fiber tear. After 10 seconds (center) sample exhibits 90% fiber tear, showing that in most of the joint the adhesive has formed a bond stronger than the material itself. After 15 seconds (right) fiber tear is complete, and bond is formed.

the adhesive may not be as strong as the adhesive forces between the surface and the adhesive. As a result, the joints fail through film breakdown.

Assuming that the correct adhesive is used, that the surfaces to be bonded are clean, and that the right thickness of the adhesive film is applied, optimum adhesive performance may still depend on the right method of application and the use of proper equipment. Among the application methods are brushing, dipping, spraying, and direct or indirect application of glue by means of roller wheel or knife.

Properties of an adhesive fall into two general categories: those relating to its physical form and processability, and those relating to its function as part of the finished article. These factors and their effect on adhesives are summarized in the accompanying table.

Keeping in mind the general adhesive principles noted, we can now profitably proceed to an investigation of the compounding of polyvinyl acetate adhesives.

Excellence of Properties

Chemically, the polyvinyl acetate emulsion formulated adhesives have excellent properties which have made polyvinyl acetate popular in industry. These include excellent aging, quick setting, high resistance to humidity or water, and affinity for many surfaces. Furthermore, adhesives of high bond strength, compared to other latices, may be obtained with this polymer. Polyvinyl acetate is a synthetic and is rigidly controlled to specifications to insure lot to lot and year to year uniformity.

Polyvinyl acetate emulsion adhesives are water dispersions and can be easily applied either manually by brushing, spraying or spreading; or mechanically by using roller coaters, dipping techniques, or other equipment. In contrast to solvent adhesives, their use eliminates health hazards and the danger of fire or explosion.

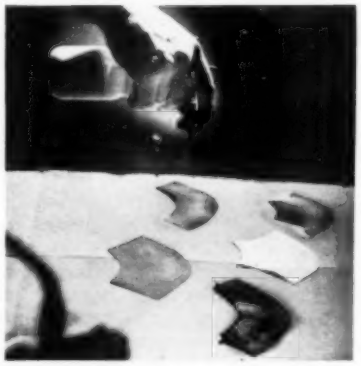
Special equipment is not required, as in the case of hot melt adhesives, as polyvinyl acetate emulsion may be formulated to give excellent bonds at room temperature and under pressures merely high enough to insure intimate contact between the surfaces being bonded.

Adhesives based on polyvinyl acetate emulsions first gained widespread use in packaging just before

Methods of Application

◀ **Knife—Spread adhesive in even coat of controlled thickness. This laboratory knife spreads adhesive on a sheet of material to be laminated.**

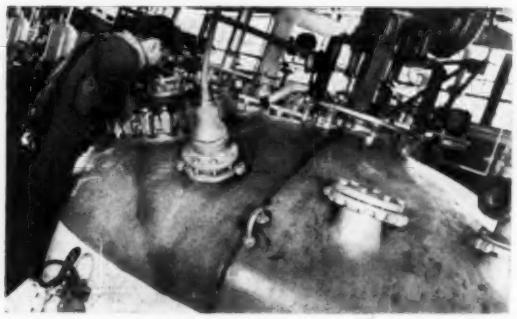
◀ **Brushing — Packager seals cartons by brushing on adhesive.**



◀ **Spraying—Box toes for shoes (the part glued inside toe of uppers) are sprayed in shoe laboratory, duplicating factory methods.**

◀ **Roller—High speed is achieved with roller wheel. Here adhesive is applied to labels.**

◀ **Dipping—In shoe products laboratory, a shoe counter (the part glued inside the heel) is dipped into adhesive by hand in same manner mass dipping apparatus operates in shoe factory.**



Vinyl acetate polymers and copolymers are polymerized under heat and pressure in reactors such as shown here.

World War II. Since then, their superior characteristics have spurred growing popularity. Present applications include corrugated case glue laps, case and box taping, wood joints, bag and multiwall bag side seams, cellophane bonding, form padding, self-sealing envelopes, foil, and drinking straws.

Plasticizers — Because they are generally used in all of the polyvinyl acetate emulsions, we can begin our study of these adhesive compounds with a discussion of permanent type plasticizers. The amount of the latter added to a compound is based on the specific end use for the special adhesive material. Plasticizers are essential in synthetic resin adhesive for improving film formation, imparting tack, decreasing drying time, imparting flexibility and gloss, and reducing cost.

Ester Type Plasticizers

Many of the common ester type plasticizers can be used with polyvinyl acetate emulsion to increase flexibility, lower the softening and heat sealing temperatures and increase tackiness. Typical plasticizers and their principal features are listed below.

Dibutyl phthalate imparts good flexibility and softening action with relatively low volatility.

Dibutoxyethyl phthalate has a much higher degree of permanence than dibutyl phthalate, and has been used for many years in food packaging applications where toxic material can not be tolerated.

Dimethyl phthalate is used in some cases because of its low cost and because it is a better solvent for bonding to cellulose acetate film or sheeting where this material is used in making windows or lamination to paper.

Tricresyl phosphate is used where flame resistance, oil resistance and low volatility are desired.

Cresyl diphenyl phosphate is more efficient and stable than tricresyl phosphate, and offers better low temperature characteristics and abrasion resistance.

Methyl phthalyl ethyl glycolate has excellent light stability, and is exceptional for bonding acetate overlap to paper.

Butyl benzyl phthalate is considered better in some applications than dibutyl phthalate because of its lower volatility, greater film toughness, and improved moisture resistance.

Plasticizers can be readily mixed with polyvinyl acetate emulsions without pre-emulsification. They should be added slowly, while stirring, to insure uniform distribution. The mixture should be agitated for about ten to 15 minutes.

Since the addition of large proportions of plasticizer increases the viscosity of polyvinyl acetate emulsion, it may sometimes be desirable to thin with 5-10 per cent of water, based on the total weight of the emulsion, before adding the plasticizer. If any low boiling organic solvent is included in the formula, it should be mixed with the plasticizer before adding to the emulsion. For most applications, from 10-20 per cent plasticizer, based on the dry weight of the resin, is sufficient although much higher proportions may be used when soft tacky adhesives are wanted. In applications where flexibility is not essential, plasticizers are omitted and the emulsion used as supplied.

Tackifier Resins — Many of the best adhesives consist of a film former and a tackifier. The film former imparts strength to the bond while the tackifier improves adhesion to specific surfaces and may aid in obtaining quick grab. There are not many resins which yield good adhesives when blended with polyvinyl acetate emulsion. Typical tackifier resins and their properties are the following:

Vinsol is the gasoline-insoluble portion of the resin recovered from pine wood by solvent extraction with aromatic solvents. It is dark in color and cannot be used where this feature would be objectionable.

Phenol-modified coumarone-indene resin is added to polyvinyl acetate emulsion to improve adhesion to specific surfaces and to aid in obtaining quick grab.

Santolite MS-80% is a soft, practically colorless resin made by the condensation of formaldehyde with aromatic sulfonamides. It is added to improve adhesion to specific surfaces such as moisture proof cellophane.

Antifoams—Since the predominate method of adhesive application requires the use of some mechanical spreader, it is essential that modern adhesives do not develop excessive

Excessive foaming, right, can be reduced to proper amount with addition of anti-foaming agent.

foam during this application. If air is incorporated into the adhesive in the "glue pot," the solids drop in the final film and poor adhesion results. The prevention of foam in adhesives is an extremely delicate procedure for the manufacturer. Excessive amounts of defoamers must be avoided as they may lead to the reformation of foam by changing the surface tension or they may cause an oily film to be deposited on the surface preventing adhesion.

Air may be incorporated into the adhesive by the revolution of the application rolls. This causes an increase in the viscosity of the adhesive and prevents the rising of the bubbles to the surface, a condition which stimulates the formation of more foam. Frequently, the addition of materials that alter the surface tension will prevent foaming. Very small quantities of silicone antifoams and ordinary table cream have proven effective in a wide range of compounds.

Controlling the Antifoam

Anti-foams, especially the silicones, generally decrease the wetting power of adhesives and may thereby reduce adhesion substantially. The amount of anti-foam added must, therefore, be carefully controlled. Although used in percentages ranging from .15 to .2 per cent, they perform a vital function and may constitute the difference between success and failure in a given application.

Preservatives—Most adhesives are subject to decomposition of one form or another, and a preservative of some type is usually incorporated. The selection of the type and amount must be carefully considered in light of the composition and its ultimate use. Non-toxic preservatives are essential when the adhesive may be used in contact with food products. Thought must be given to the method of handling of the adhesive so as not to be harmful to plant personnel.

Aqueous adhesives containing relatively high solids ordinarily do not require preservatives. Apparently, insufficient free water is available to encourage mold or bacterial propagation. Preservatives are seldom required in excess of .15 to .2 per cent of the total weight of the adhesive, and when one considers the relative cost of this material compared to the possible loss of the total adhesive, it is indeed more economical to include at least some type of preservative in most adhesives. The great variety of strains of mold and bacteria make it difficult to find any one so called "all purpose" preservative, but currently used materials may include phenol, formaldehyde, chlorinated phenols, benzoates and benzoic acid derivatives.

Wetting Agents—Proper wetting of a surface is essential for good adhesion. Careful selection in the type and amount of certain wetting agents may be helpful in accomplishing this operation. However, since this is also a function of surface tension, one must use extreme care in the choice or foaming may result. Excessive penetration caused by the improper use of a wetting agent, results in a low concentration of solids being deposited on a surface to be bonded. The amount varies from .1 per cent to not more than 1 per cent, yet its presence may dictate success or failure.

Deodorants—Perfumes and flavorings are on occasion used to give characteristic odors or tastes to adhesives. Their use is not widespread, but frequently, it is desired to mask the natural odor of a particular ingredient. Potato dextrines, for example, are objectionable to some envelope manufacturers because a slight taste is imparted to the envelope seal. So a mild perfume or flavoring is added. In other cases, the modifying agents may impart a pronounced odor to an adhesive. Fortunately, most adhesives have very mild odor and little or no masking agent is required.

Factors Influencing Successful Bonding

- **Total Solids**—A basic factor determining weight pickup and drying time. Best results with polyvinyl acetate adhesives require 45 to 55 per cent total solids.
- **Rheological Properties**—Optimum rheological behavior depends on the coating method used. Once established by trial and error, it can be reproduced by using a viscosimeter.
- **Stability**—Storage stability or pot life varies with the adhesive from a few minutes to several years. Some compounds are supplied in stable parts for point-of-use mixing.
- **Appearance**—Color or opacity is an important factor in the bonding of transparent films. Transparent or opaque, colored adhesive is obtainable from polyvinyl acetate.
- **Odor**—Adhesives based on polyvinyl acetate emulsions are relatively odorless. The odor of compounding ingredients can be neutralized by using reoderants.
- **Bond Strength**—This is a fundamental property of any adhesive. Exceptionally high bond strength can be obtained with compounded adhesives based on polyvinyl acetate emulsion.
- **Rate of Bond Strength Buildup**—Though generally desirable, this property is usually obtained at the expense of stability and tack life. The balance struck depends upon the end use.
- **Tack Life**—Varies from minutes to months depending upon the adhesive type. Care should be taken that in lengthening tack life, final bond strength is not weakened.
- **Aging**—Required life of the adhesive bond should depend upon the expected useful life of the article joined. Properly compounded, polyvinyl acetate adhesives age extremely well.
- **Miscellaneous**—Special adhesive properties such as freedom from foam and stability at low temperatures may be incorporated into the adhesive by careful compounding.

Operator mixes adhesive in 15-gallon drum with portable mixer just before application.

Fillers—Mineral fillers such as clay or whiting are used for some applications to increase total solids and decrease cost. Since fillers decrease tack, only small amounts are used in adhesives for which these properties are critical. For example, in formulating heat seal adhesives for paper, clay added as a concentrated slurry helps keep the adhesive on the surface of the paper and prevents blocking at temperatures below the heat seal temperature. The adhesive bond in this case remains strong enough to cause failure in the paper rather than in the adhesive layer when samples are pulled apart.

Corn starch has been used as a filler in polyvinyl acetate where heat is involved in obtaining the final bond. When the heat hits the corn starch it swells the starch and quick grab is obtained. Calcium carbonate is another type of filler used in polyvinyl acetate adhesives.

Solvents—Small amounts of solvent are sometimes added to dissolve any coating present on the surface to be bonded. In addition, small amounts of solvent are sometimes added to the polyvinyl acetate emulsion to increase tackiness and speed of grab. Typical solvents are carbon tetrachloride or trichloroethylene. Carbon tetrachloride has proven to be a suitable solvent for wax removal. For cellulose acetate film, it is generally necessary to provide a solvent. Ethyl acetate and isopropyl acetate usually serve this purpose.

Thickeners — Thickening agents may perform the function of adjusting viscosity, keeping the adhesive from penetrating too far into the material being glued, and aiding in the adhesion to specific surfaces. Commonly used thickening agents follow:

Methyl cellulose is effective in a wide range of compounds and is probably the most commonly used material. When methyl cellulose is used, a steady slow rise in viscosity is often observed.

Polyacrylates are more expensive but smaller amounts are usually required. In some compounds better shelf stability has been observed than with methyl cellulose.

Polyvinyl alcohol in a viscous water solution tends to add to the speed of grab of the compound. A decrease in viscosity is at times associated with polyvinyl alcohol.

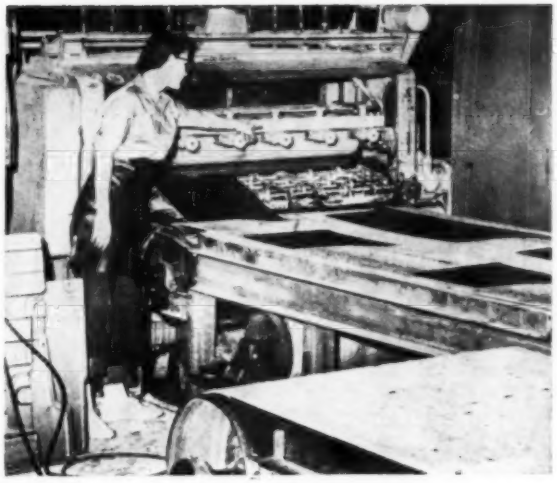
A combination of thickeners is often employed to give maximum stability and minimum viscosity change with time. For example, methyl cellulose and polyvinyl alcohol may both be added so that the decrease in viscosity associated with polyvinyl alcohol is offset by the rise which occurs with methyl cellulose and a flat curve of viscosity versus time is obtained.

Compound Preparation — Most properly prepared compounding ingredients may be easily blended with polyvinyl acetate. It is important, however, that agitation be rapid enough to insure that the entire mass is kept in motion and that no localized high concentration, which may cause instability, is allowed to form. On the other hand, very rapid agitation is to be avoided in order to prevent foaming and the possibility of coagulation by mechanical action.

The order of addition of materials may be varied for different compounds. The most common procedure is to add all materials to the polymer: first the plasticizer, tackifying resins, wetting agents, defoamer, and preservatives; then the thickeners; and finally the fillers.

About the Author . . .

ALEXANDER A. NICHIPOR's 13 years with Dewey and Almy have been spent in the adhesives field. He was a chemist for six years in the Shoe Adhesives Laboratory, then transferred to the Adhesives and Coatings Division Laboratory where he gained five years of practical experience formulating adhesives based on polyvinyl acetate emulsions. In 1956 he joined the Organic Chemicals Customer Applications Laboratory, specializing in helping adhesives manufacturers compound adhesives with Dewey and Almy vinyl acetate polymers and copolymers.



View of the modified spreader with hood removed. The operator is pointing to the micrometer-adjusted stripper fingers.

Solvent Control

assembly line laminating requires close control of solvent evaporation

Accurate control of solvent evaporation is a prime factor in the success of any laminating operation utilizing rubber-base contact adhesives and mechanical spreading. Because the solvent used in these quick-setting bondants evaporates at a fast rate, provision must be made for maintaining uniform adhesive viscosity during the application process. Properly employed, solvent-type adhesives can be particularly valuable under a variety of circumstances and with various products.

At the Lobdell-Emery Mfg. Co., Alma, Mich., for example, an efficient assembly line technique has been worked out for roller spreading the top surface of flat mats used in the manufacture of end gates and folding seats for station wagons. Stabilization of the adhesive's solvent content is assured by a Black Brothers roll spreader modified to minimize evaporation and to automatically replace any solvent unavoidably lost.

Design Modifications

Chief among the design modifications are a hooded spreader and a series of automatic solvent feed drippers. The hood not only retards solvent evaporation, but improves working conditions around the machine by inhibiting the spread of toxic vapors. The amount of solvent inevitably lost during application is immediately replenished by the feed drippers which operate at a speed equal to the rate of loss. In this way, optimum viscosity of the adhesive is stabilized to a degree which could not be equalled by the spraying process previously employed.

As with conventional spreaders, the doctor roll of this modified unit operates directly against the application roll. Proper glue-spread thickness is obtained by making the doctor roll sensitively adjustable to and from the application roll. The crotch formed by these two rolls working together provides a supply reservoir for the adhesive being spread.

Solvent Dripper Location

In the Lobdell-Emery installation, the series of solvent drippers is located directly over the top roll crotch and is fed from a tank mounted directly above the glue spreader. Small needle valves on the dripper feed pipes make for extremely sensitive control of the entire operation.

As is often the case, the glue spreader of this unit operates in conjunction with a conveyor which receives the spread material on the machine's outfeed side. Various relationships between spreader roll speed and conveyor travel may be set up by adjusting the variable-speed mechanism in the application roll drive. For example, in this operation it was found that by establishing a conveyor speed greater than that of the application rolls, spread pieces on the belt could be separated by distances that made for easier handling down the line.

Sheets received by the belt conveyor are carried under a forced-draft system which serves to draw off excess vapors and to accelerate airflow over the spread surfaces. By this means, proper tackiness of the adhesive is swiftly obtained and the mats made ready for bonding to metal back-up panels.

Because the end of a glue-spread piece may sometimes follow around the application rolls, the outfeed side of glue spreaders is conventionally equipped with stripper fingers whose ends are positioned close to the roll. On the unit described above, micrometer adjustments of the strippers permit the ends to be located so that they are as near the roller as is possible without the danger of damage through actual contact.

Rubber-Base Adhesives

Where rubber-base contact adhesives are employed, spreader units are usually equipped with specially grooved metal gluing rolls and precision ground nickel-chrome-coated doctor rolls. However, when the adhesive is to be spread on delicate aluminum honeycomb core material, as is often the case in the aircraft industry, grooved resilient rubber application rolls are used.

Note: The photograph used here was furnished by Black Brothers Co., Inc., Mendota, Ill., makers of the modified roll spreader discussed in the article.

Adhesion Problems on the Production Line

Adhesion problems on the production line may be classified in a number of ways. For the purposes of simplification, however, they can be considered as falling into two general areas: problems that arise in day-to-day operation of an established line with approved adhesives, and problems concerned with the production line testing of new adhesives.

In the following investigation of these problems, the term "adhesion" will be used to denote the process of applying an adhesive to one of the surfaces to be adhered, and the machine clamping of the adherends until the adhesive sets. Such a definition calls for consideration of not only the properties of the adhesive and the adherends, but also of the operations involved in putting them together.

Defining the Problem

The first step in any problem solving is recognizing and defining the problem. Obvious and serious problems demand immediate action and their solutions are often simple because the difficulty is easily recognized. However, the little, elusive, even insidious problems to be discussed here, may have complex effects before they are recognized. These are the problems with which we must live and which have to be resolved as we go along. They seldom cause the line to be shut down completely, but result in slightly impaired quality, a certain percentage of defects, short periods of down time, or added labor.

Some individuals find it difficult to understand why there should be any problems on an established production line. The extreme view in this case is that all these problems should have been worked out long ago. It should, however, be realized that the operating norm is one of continuous compromise between cost and the perfect package.

In the problems of day-to-day operation, there is an area where the causes are fairly distinct. We are well acquainted with the fact that increased operating speeds generally bring on complicating problems. The case sealer is a well known example here, having initially been designed to have a compression time quite adequate for the setting time of the adhesive. Depending upon the margin of safety designed for the basic operation, an increase in operating speed may or may not cause any problem directly. However, one day the board arrives with a higher moisture content; and with the margin of safety gone, due to increased speed, the cases aren't sealed properly. Then comes the report: "There is something wrong with the glue. It is *not* setting fast enough."

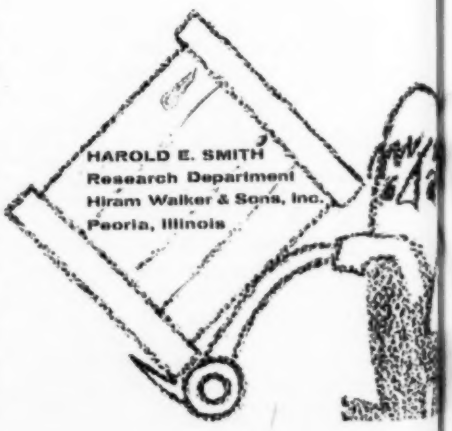
When the trouble-shooter arrives on the scene, he doesn't know whether the sealer adhesive is at fault or not. Perhaps the machine operator added too much water in diluting the glue, or used hot water, or is applying too heavy a film, or the board has a lower absorbency, and so on. The rapidity which such a problem is solved depends upon how closely the trouble-shooter works with the production people and upon his analytical questioning technique.

It should be recognized that a considerable number of adjustments are required for "setting up" one of the more complex packaging machines each day—particularly for a package change. It is easy to assume that a skilled mechanic or set-up man will adjust the machine the same today as he did yesterday or whenever a given package was last run. Some of these adjustments may be made with the aid of gauges and scales, but for many of them, skill and personal judgement are the only determinants.

There are those who will insist a skilled mechanic can duplicate his machine settings in the daily set-up. He can, insofar as his sense of touch serves him well. Of course, there are occasions when such duplication of settings is not desirable. This occurs when inherent variations in adhesives and other package components necessitate alteration of what might be considered a standard adjustment. Again the subjective factor enters, and possibly inept machine adjustments are made; but not because of any lack of skill or integrity on the part of the mechanic. He has no fixed standard to go by.

Glue Film Thickness

For instance, achieving a workable glue film thickness is a matter requiring considerable judgment, as well as trial-and-error. The usual tendency is to regard more and yet more glue as the cure-all for faulty



adhesion. In order for the trouble-shooter to deal effectively with problems in this area, he must recognize that the subjective senses are fallible and in no way reflect on personality.

Mention has been made of another source of problems: "inherent variations in adhesives and other packaging components." The term "inherent" is used here to denote both the significant variations, which cause difficulty, and the insignificant variations, which merely cause complaint. Some of the common complaints we hear are: the adhesive is thinner than the last batch, the color is different, it doesn't spread as well, it doesn't feel as sticky, etc., etc.

The trouble-shooter must work closely with production personnel.

Atmospheric conditions are often blamed for difficulties on the packaging line. When they constitute a real factor, it is because they make for variations in important properties of the packaging materials, *e.g.*, high humidity may cause the adhesive to have a slower setting time. Depending upon the occasion, some of these complaints may be real, some imaginary; and the real ones may or may not be significant. It is always well for the trouble-shooter to listen sympathetically, for somewhere in this effluence may be the very clue for which he is seeking.

Before we pass judgment on the adhesive manufacturer regarding his product variations, let us take a closer look at the frustrating situation which confronts him. Adhesives, with few exceptions, are complicated mixtures of complex compounds. The chemical reactivity of these materials is less predictable than that of simpler compounds. Therefore, even elaborate processing controls cannot cope with all the variables involved. However, competition and customer pressure keep the manufacturers striving to improve this situation.

Variation in adhesive viscosity is the subject of frequent inquiry. About a year ago, in the course of such a discussion about the type of heavy labeling adhesive known as the "jelly-gum", a representative of one of the larger adhesive manufacturers related that the batch-to-batch variation in viscosity is greater than most manufacturers care to admit. This means that if a customer's viscosity specification has a range narrower than the manufacturer's production range, the manufacturer must select batches in order to comply. Those who do not have such specifications will receive, over some period of time, batches of adhesive with viscosities over the entire manufacturing range. Individual batches will be sufficiently uniform, but subsequent batches are apt to be thinner or heavier.

Before rushing off to buy viscometers and establish viscosity specifications, let us take a look at the production record. Many packagers have been buying and using adhesives for years without the benefit of viscosity specifications. Most of the time these adhesives are used without complaint. And where complaints are raised regarding viscosity, the majority of these cases end up with the adhesive being accepted and used anyway. Additional adjustments are made on the machine which sometimes must be checked more frequently, but there is no real impairment of production. Only when the problem is so acute that additional personnel or reduced line speed is necessary to maintain an efficient operation or a given quality level, can there be justification for doing something about the viscosity problem—or any other problem for that matter.

To summarize: an adhesion problem is seldom the manifestation of only one factor. It is the pyramiding of several factors or conditions aggravating each other to a point where they begin to add to the costs or impair quality. Very often, compensating for one of these will be enough to keep production rolling for a time. One may even think that the real cause has been dealt with, until other factors or conditions become more acute and further corrective measures must be taken in order to insure against recurrence.

Moisture and humidity are always a problem.

Interacting factors to be considered include: (1) increased operating speed; (2) variations in machine set-up due to the human elements or to package changes, and (3) variations in the properties of the packaging materials.

Pre-planning will always be a benefit.

Let us now consider the problems in the trouble-shooting procedure itself. Because of his daily, continuous experience in line production, the mechanic or machine operator is ideally situated to be the trouble-shooter. He serves in this capacity to a surprising extent in that he makes many machine adjustments on a "trial and error" basis. However, the mechanic is not usually a trained observer and may be easily confused, or may tend to overcompensate.

When the situation becomes more than the mechanic can handle, a trouble-shooter in the person of the mechanic's immediate supervisor, someone from the higher management group, or from the technical staff, or a service representative of one of his suppliers is called in. Often a group composed of these people works as a team.

Although the trouble-shooter is often subjected to considerable pressure, on behalf of production, there is no standard method for him to follow in attacking a problem. He must rely on his experience, judgement, and knowledge of human

operation objectively as an operation, often, but not always, affected by human elements. He should avoid jumping to conclusions. Further he needs to be well informed on the details of the operation in order to avoid the cardinal sin of trouble-shooters: time-wasting suggestions.

In order to get all the help the line personnel are capable of giving, he must have a friendly manner and be a good listener, remembering that he may not get the complete story from any one individual. A good rule to observe during this fact-finding period, a rule that incidentally is paramount in brain-storming sessions, is "no negative comment". Save passing judgment until later.

The listening should be interspersed with questions of the "how, what, when, where, and why" type: "What *is* the problem? *Is* it the adhesive? *How* is it affecting production? *In what way* is it being a problem? *What* are you (the mechanic) doing about it?"

The Right Question

At this point, it is most advantageous if the trouble-shooter has been called in while the production line is still going, so that he has a chance to see first-hand what is happening. The critical task is evaluating the various comments in the light of one's own observations. Here again, getting the right answer is often a matter of hitting on the right question.

If the real cause of the difficulty is still not clear, one should go down the list of possible causes and ask about each factor such questions as: "*How* is this a part of the problem? *Is* it relevant? *Does* this defect persist with a different adhesive or other supply change? *What conditions* have changed since the time when the problem was not apparent?" It is possible that the mechanic and line foreman or supervisor can render valuable assistance in this run-down. Through the proper questioning techniques, they will often be quick to suggest remedial measures not previously brought out.

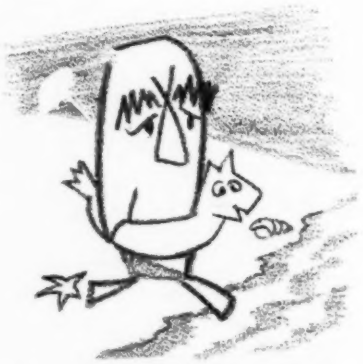
At this point, the cause of the problem has either been pin-pointed or remains obscure. Once the cause has been identified, the remedial action is generally self-evident.

Where the cause is not yet clear, the analysis of the operation will reveal avenues of production testing. When it appears the adhesive or other packaging material is at fault, it behooves the trouble-shooter to get samples of defective packages, along with samples of the supplies in question, for reference and laboratory checking. In addition, the need for consultation with the service representative of the appropriate supplier is indicated.

Consulting with the supplier should serve several purposes: (1) prevent a recurrence of the difficulty, (2) arrange for the return or disposal of the questionable merchandise, or (3) determine how to use it with the least difficulty. This last point may require additional line tests before the material is actually run. These discussions may bring about the review of recommended preventive measures which will be discussed later.

Complaints to suppliers should be made judiciously. Evidence should be preserved in order to substantiate all claims. All too often, the service representative arrives, only to find that the material in question has been used up and all that remains is the machine operator's recollection of what happened.

Depending on plant organization, the trouble-shooter may or may not be responsible for production. If he is, he must have the authority to put remedial measures into effect. If, on the other hand, he does not have the authority to take remedial action, he can act in an advisory capacity only.



The wet-dry balance must be considered.

Giving advice is a delicate matter. For this reason, it is helpful to use some indirect method such as the questioning technique. Asking "What would happen if this or that were done?" is a common way of implanting ideas which might otherwise be resisted, particularly in the area of machine adjustments. It is up to the trouble-shooter to use his judgment in deciding the best approach for the circumstances.

When a packaging material appears defective or is not performing as expected, there are two alternatives for handling the problem. If adequate stocks are on hand, the lot or batch in question can be set aside until the service representative can decide what is to be done. More often, it seems that the commodity is in short supply and must be used at the expense of quality or efficiency.

When the machine operator realizes he has no choice but to use complaint material, he will usually take steps in earnest to alleviate some of the difficulties. He may display unusual ingenuity and intuition in learning how to overcome these difficulties. It occasionally happens that, after some time, the material in question is performing as well as that which was deemed satisfactory.

Chronic Problems

Some problems may truly be called "chronic" in that they are persistent, recurrent, and resist solution. Sometimes the causes are well known, and include such conditions as worn or obsolete equipment, poor machine design, use of materials not well suited for each other in a given package, poor package design, and outdated supplies (glue). The reason that something is not done is that the cost of relief outweighs the annoyance factor.

With other problems, there are so many contributing causes so intricately related that altering one of these factors may prove effective on one occasion but not the next.

Industries faced with these seemingly insoluble problems are responsible for the founding of many of the trade associations and professional societies. These organizations provide the means for people representing these diverse industries to get together to attack similar problems.

The technical committees constitute one of the means of working out solutions to these problems. Good examples are the Packing Institute's committees on Adhesion to Board and Adhesion to Glass. Last winter, the latter group issued a "Manual of Testing Methods for Labeling Adhesives" which may be procured at Packaging Institute headquarters. The Adhesion to Board Committee is doing similar work in its particular area. This is the first time that standardized methods for some of the common tests on adhesives used in packaging have been made available.

Most suppliers of merchandise

furnish recommendations to help customers derive the best use and service from their products. When the customer strays from the recommended practice, the chances are good that he will run into new difficulties of one sort or another. This does not mean that a packager should not try a new application for a machine or a new use for some material, but that he should be prepared to do some extra problem solving in the process.

Problems have a way of pyramiding.

For handling specific packaging materials on an established line, certain practices have been found, through industry-wide experience, to give optimum results. For instance, the paper experts tell us that paper used for bottle labels will give us the least difficulty if it is always maintained in the range of 40-50 per cent relative humidity at room temperature, and that no process or conditions should be tolerated that will alter this equilibrium.

Unfortunately, some designers like embossing and hot varnishes on labels. This alters the moisture equilibrium. Therefore, production must cope with additional problems as a result.

Be a good listener.

Five years ago, the Adhesion Committee issued a dual report dealing with the proper procedures for selection, handling, control, and usage of glues. The titles are: Report No. 1—"A Recommended Approach for Proper Selection, Control and Usage of Glues in Production Plants," and Report No. 2—"Proposed Procedure for Proper Handling and Usage of Glues in Production Plants." These titles are perhaps a bit bulky, but the content is concentrated. Briefly, the recommendations in these reports cover the following subjects:

(1) Delegation of group or individual to test and screen new adhesives.

(2) Plant testing of new adhesives.

(3) Approved glue list.

(4) Delegation of group or individual to sample and test established adhesives.

(5) Delegation of responsibility for procuring, storing, and handling adhesives.

(6) Written precautions and procedures for handling and using adhesives.

Plant experience and committee discussions have resulted in the following recommendations for handling and using adhesives.

Regarding use in production—

(1) Glue film should be continuous.

(2) Glue film should be kept to the minimum thickness that still provides satisfactory adhesion.

(3) Adhesive transfer surfaces should be kept smooth and clean.

(4) It is better to add small amounts of adhesive frequently to the glue pot than to try to make a large filling last all day.

(5) Covers should be provided for glue pots having a large area of glue exposed.

Handling and Storage—

(1) Maintain no more than 3 months' supply of adhesives (for some types, 6 months is permissible).

(2) Use the oldest containers first even though the mechanic complains, "We never get to use any fresh glue."

(3) Adhesives should be regarded as perishable materials and should be protected from wide deviations of room temperature.

(4) Where the warehouse temperature is different from that of the packaging room, several days prior to use, containers of adhesives should be transferred to an area having the same temperature as the packaging room.

(5) If specifications are not used, the adhesive should at least be given a visual inspection before being delivered to the packaging room.

(6) Auxiliary handling equipment should be made of an approved plastic or stainless steel to avoid metal contamination.

(7) Ready-to-use adhesives, not requiring mixing or diluting, eliminate one more places where something can go wrong.

(8) Strong measures should be taken to prevent different types of adhesives from being mixed or used with the wrong materials.

When mention is made of specifications, most people think of elaborate tests and numbers. In some instances, however, specifications of the very simplest sort are adequate. For example, they might take the form of a brief statement based on a performance requirement. Judgement must be used in keeping specifications useful and practical.

Unfortunately, correlations are not well established between the available tests and performance. For certain critical operations, tests for such properties as solids content, viscosity, pH, and setting time help to assure the uniformity of the new batch as compared to the last batch. On the other hand, these tests are of relatively little help in predicting machineability.

Paste-Up Specimens

Where the service requirements of the package are considered rigorous, it is well to prepare paste-up specimens and subject them to service conditions, as a further check. Service condition tests are included in the "Manual of Testing Methods," previously cited, and further help may be had from the "A.S.T.M. Standards on Adhesives."

Under the guidance of Dr. S. L. Adams, of Seagrams, the packaging adhesives section of A.S.T.M. Committee D-14 on Adhesives is currently developing tests and recom-

mended specifications for adhesives used for bottle labeling and for case sealing. Tbis work will be published in subsequent editions of the Standards.

Foremost in the consideration of other facets of the adhesion process is that of keeping the equipment in good condition. Where different packages are run on the same line, some system is needed to take care of the change parts. Such a system would include a file (such as a Cardex) of the various packages. The card or sheet for a given package would have a complete list of the packaging materials and the change parts required, each designated with an appropriate code number. Pegboard racks are sometimes used for storing change parts near the machine to minimize damage and make them immediately available. A wrong part, even though it is very similar to the right one, can cause no end of trouble.

Proper public relations cannot be over-estimated.

The various packaging materials must, of course, be kept in a clean and orderly manner. Commodities like paper and cellophane are subject to drying out, particularly if storage is prolonged. If an extended period of storage under uncontrolled humidity conditions is contemplated, rolls and bundles of these materials should be wrapped and sealed in a moisture proof wrapper. The most neglected point in this area is the partial roll or bundle returned to storage from the packaging room. It should be wrapped and resealed in order to preserve its prime condition for the next time it is to be used.

It is in order, at this point, to consider how package design may give rise to production line difficulty. Designers should work as closely as possible with production people so that "impossible" combinations of materials are not passed on to production for assembly. Aluminum foil and plastic films are being used more widely every day. A production supervisor, accustomed only to handling starch base adhesives, and suddenly finding himself with the task of adhering a film or foil, will have innumerable problems to solve before the line regains its operating efficiency.

Design of the Package

In the design of the package, such considerations as shape and proportions of the package, shape and portions of components, dimensions, clearances, tolerances, type of packaging materials, etc., affect both appearance and production.

Other important questions are: Can the package be run on existing equipment? What equipment changes will be necessitated? What other mechanical changes will be needed? What will be the cost of change parts? What will be the effect on the line personnel? Will more labor be required? Can the package be simplified and thus made easier to run? Undoubtedly, the list could be added to. Despite the number of questions asked, it always seems that more questions arise during preliminary testing on the line.

Production deadlines are presumably necessary to fit sales plans. However, this often works to the detriment of the package because of insufficient time to pre-test and properly work out production details. Deadline pressure on the supplier results in lowered quality for the same reasons. The organization with the closest cooperation between design and production will have the least difficulty in getting a new package into production and onto the market.

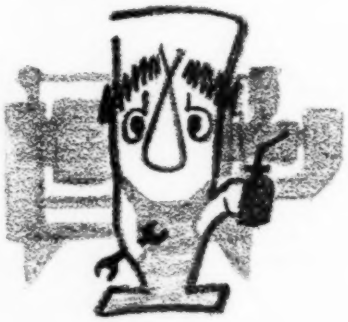
It is impossible to foretell all the problems that will be encountered. Occasionally, some prize ones appear only after production is well under way. The solution of such problems will be simplified when adequate time is permitted to work out the more obvious ones in advance.

Laboratory testing provides a basis for preliminary screening of new materials offered almost daily by manufacturers. By this means, products suitable for new packages, or useful in meeting old package problems, are found. Testing is essentially the same for both purposes, as an examination of a basic testing scheme from the preliminary screening to production line testing will show. The new adhesive provides a good example.

The purpose of laboratory testing is: (1) to determine whether the adhesive will withstand the service or storage conditions that the package is likely to encounter, and (2) to enable personnel involved to predict how the adhesive is apt to perform on the production line.

It is presupposed that the packager has some laboratory facilities where preliminary testing can be done. Usually a small sample of adhesive will be submitted by the manufacturer for this preliminary work. Comparison tests with satisfactory adhesives should be made on whatever physical properties have been deemed important to the packaging operation. In addition, "paste-ups" of samples of the materials to which the adhesive must adhere are prepared for checking their durability and performance under various service conditions.

If the adhesive fails in service-condition tests, or has an adverse effect on the adherends, it is rejected. In the situation where there is no comparable adhesive presently in use, predicting line performance is all the more subjective and necessitates greater care in line tests.



Equipment should be kept in good condition.

An adhesive that has withstood this first line of scrutiny is approved for production line testing. Since it is so difficult to predict the line performance of an adhesive, it is not uncommon to give it the benefit of any doubt in this regard.

Careful planning is required for production testing—particularly with respect to personnel on an established line. Two approaches are used. One involves secrecy—the adhesive for testing is placed in the

same type of container as the presently used adhesive, and is similarly marked. Since no one on the line knows the difference, this will supposedly effect a control on the human variables and preserve objectivity. Of course, it will work only for similar types of adhesives where there are no differences such as color, viscosity and tack to be observed visually. Even then, the subjective perception of the machine operator is easily underestimated. Once his suspicion is aroused, the chances of a truly objective test are nil.

Through thick and thin we are all in this together.

The other approach is to carefully inform the proper individuals on the production line about the pending test—the purpose, how they can help, and the possible benefits. The latter should be emphasized as the success of the test depends, to a large extent, on these people wanting to improve their operation and being willing to give the test adhesive every opportunity. This prepartion is highly important because production people tend to misinterpret change on an established line as a threat to their job security. In addition, they know the test is apt to necessitate some down time and additional work. This type of resistance is less likely to arise when a new package is being developed.

Enough of the test adhesive to supply the line for a day is ordered. A sample is taken and subjected to sufficient laboratory testing to confirm that it is essentially the same as the original sample.

The person doing the laboratory testing should be on hand for the production line testing. On many occasions, it is also desirable to have the supplier's service representative present. In the event of difficulty, all concerned will have a chance to observe what really happened. It is good insurance to have a spare glue pot handy in case the test adhesive must be taken out of the machine.

If the test adhesive appears to be performing satisfactorily, it is generally safe enough to let it run for the rest of the day, or at least until the lunch break. Samples of finished packages should be taken for rechecking performance under service or storage conditions. Depending on the importance of this test, samples may be held for regular inspection for as long as a year, or even longer.

Further test running is planned for several days to a week in order to determine mileage or usage rate figures. Batches for this purpose are also sampled and laboratory checked. When the adhesive has successfully passed these tests, it can then be placed on the approved list. If specifications are to be set up, the test data on all the samples will provide a basis.

This testing scheme can be shortened or otherwise modified. The basic premise of laboratory screening followed by careful production line testing and service-condition checking is generally applicable to other packaging materials. Where the packager does not have laboratory facilities, he must rely upon the supplier's information and recommendations. This necessitates that a good relation be maintained with the suppliers—a point of mutual concern for packagers and suppliers alike.

Modern day merchandising has made us more aware of appearance and quality. In addition, rising costs necessitate a closer look at production efficiency. Heretofore, the little problems have been masked by the larger ones. It has now become economically expedient to attack some of the more elusive problems which are often combinations of material shortcomings and human variables.

Objective methods are used insofar as they are available. However, when nothing else is available, the value of subjective methods should not be underestimated—especially in the area of subjective problems. The trouble-shooter must be a good detective, able to ask pertinent questions, and well versed in human relations.

Identifying the problem and clearly defining the causes indicate the remedial measures. The best way to avoid or minimize difficulty from the more complicated and obscure problems is to enforce proper preventive measures.

Improving an existing operation and developing a new package necessitate the testing of new materials. Laboratory screening reduces production line testing. Specifications and controls can be set up as needed.

Good human relations in all quarters are necessary for smooth operations, effective trouble-shooting, and successful testing.

About the Author . . .

[The author originally presented this paper at the 20th Annual National Packaging Forum of the Packaging Institute, Inc.]

HAROLD E. SMITH joined the Research Department of Hiram Walker & Sons, Inc., in October, 1942. At that time he was primarily concerned with analytical methods research on a wide variety of materials. In early 1949, packaging adhesives was added to the list for testing methods investigation, and subsequently all packaging materials were made subject to laboratory tests. His present duties include screening new adhesives, trouble-shooting adhesion problems on the bottling lines, developing test methods for all packaging materials and advising production on the use of these materials. Mr. Smith is a member of the American Chemical Society; A.S.T.M. Committee D-14 on Adhesives; and Committee on Adhesion to Glass of the Packaging Institute. He is the immediate past-chairman of the Committee on Adhesion to Glass.

Defoaming Agents for the Automatic Application of Animal Glue

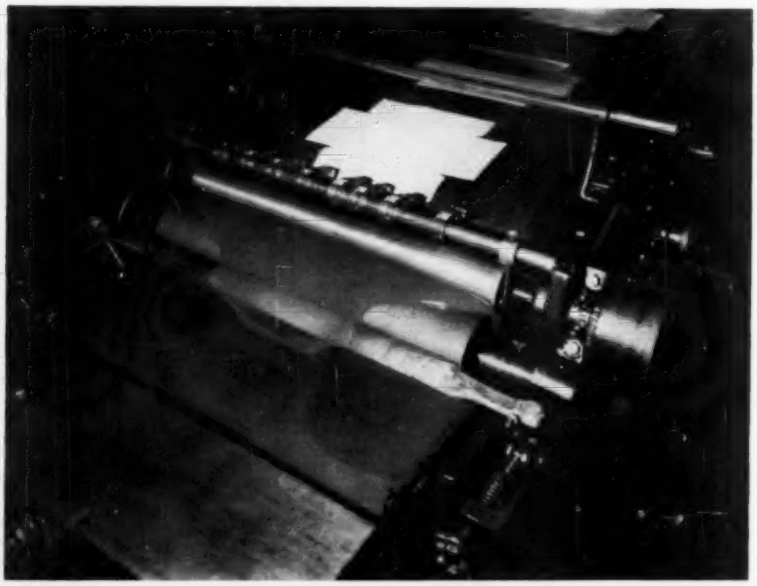
By JUNE N. SAFIR and ALBERT W. SILVAIN
Nopco Chemical Co., Newark, N.J.

Defoaming agents, which have made it possible to adapt glue to high-speed joining operations, are helping the glue industry make a comeback. Despite having lost one-third of the adhesives market to synthetic resins as of 1954, the animal glue industry shows signs of recapturing a significant area of the adhesives picture.

Among the reasons for this is the lower cost of hide and bone glues. Equally important, many glue users like the abrasive coaters, for example, prefer the familiar natural products because they have found them so adaptable. They favor an adhesive that is more flexible than the synthetics and that can be applied without extra equipment such as heating units to make them bond. In packaging, the flexible and non-warp glues are still the major bonding agents used by the gummed tape and set-up box manufacturers. In bookbinding and woodworking, animal glues continue to be standard adhesives. Paper and textile manufacturers still use millions of pounds of animal glue for sizing each year.

The new trend is supported by the following statistics. Figures, released this year by the Adhesives Manufacturers Association of America, point to a $1.2 million rise in glue sales for packaging purposes alone since 1950. Estimates on the coated adhesives market in 1955 showed glue holding its own with a $6 million share.

Glue is selected as a binder because of (1) its specific adhesion to wood, leather, paper, and textiles, and its mechanical adhesion to surfaces it cannot penetrate, such as glass; (2) its strong, elastic film that is noncrystallizing and insoluble in oils, alcohols, and non-aqueous liquids; (3) the resistance of its dried film to shock, solvents, heat, cold, and moisture; (4) the durability of its bond when properly stored, and (5) its rapid set due to its peculiar jellying ability.



A high-speed glue applicator in operation. The glue is being applied to paperboard.

Universality of Glue

Glue's singular, quick-setting property deserves emphasis, for it makes glue the most adapatable of all adhesives. A reversible colloid, animal glue can be rapidly changed from a fluid state to a firm jelly by just a small drop in temperature. This jellying action can also be reversed to obtain a long "tack" period, with a temperature rise of a few degrees. Where desired, therefore, animal glue can effect almost immediate bonds that quickly become permanent. It is this type of adhesion that helps make possible the high-speed gluing operations in practice today.

Like so many of its competitors, glue requires chemical defoamers for its mechanized applications. Unless defoaming agents are added, bone and hide glues, including technical gelatin, produce a rigid, persistent froth when spread by brush or roller. Frothy glue interferes with the efficient operation of glue applicators. Also, because the glue cannot be made to lie flat, it cannot be applied in a thin, even film for uniform adhesion. Foamless glues therefore are required by industries using automatic mixing and spreading equipment (except those manufacturing a few products, e.g., dolls and matches).

Aware of these factors, manufacturers who make the dry animal glue used for general adhesive purposes sometimes include defoamers for their customers' benefit. Compounders, who purchase the ground glue and add chemicals to modify or

liquefy them, must use chemicals' to combat foaming. If they heat the glue mix with direct steam from open jets, excessive foaming occurs. If they use a very hot (160°F.) drying system after chilling and extruding their glue solution, they need nonvolatile defoamers that will not flash off and leave a foamy glue. (Among glue consumers, sizing manufacturers also employ agents to prevent the foaming caused by surface-active penetrants used in glue sizes.)

Heavy Stable Foams

Other substances responsible for the heavy, stable foams of glue solutions are insoluble salts, excess alkalies, and soluble proteins like peptone. Since animal glue is derived from the protein collagen occurring in vertebrate connective tissues and bone, it is small wonder that its industrial use is complicated by foam.

The ways in which chemical additives attack the foam of animal glues are determined by the chemistry and structure of foam. Foam is a gas dispersion in an impure liquid. Whether prolonged like the "head" on beer or fleeting like white caps on waves, all foams are a honeycomb of bubbles, each walled in by a mobile, viscous film. The formation of foam is due to the interplay of surface tension, viscosity, concentration, surface area, and temperature. In glue solutions, pH is also a factor because the relative stability and solubility of protein foams are affected by electrical changes in the colloidal molecules.

One of the most reliable means of glue foam control is the use of chemical defoamers. Their destruction of foam, involving a decrease in surface tension, is carried out primarily in two ways. A defoamer either mechanically breaks the liquid films surrounding the bubbles or else it substitutes itself for the film. The mechanical method, for its part, employs stress. When a surface-active defoaming agent is sprayed or dropped onto foam, it spreads out and exerts great pressure on the bubbles' surface films. At the point where their films are contacted and subjected to stress by droplets of the defoamer, the foam bubbles will collapse. The defoamer, unchanged, travels on through the films to wipe out the foam.

The substitution method is based upon chemical displacement. The defoamer collects at the film interfaces and, having little compatibility with the foam, forces its liquid away. The film will rupture at the place where it is composed entirely of the defoamer. In other words, a liquid (the foam) capable of supporting stable films is displaced by a liquid (the defoamer) that does not have that property.

Achieving the Purpose

How well a defoamer achieves its purpose depends largely upon how it is made, selected and applied. A defoamer for animal glue may be composed of any one of a number of chemicals, e.g., a higher alcohol, polyalkylene glycol, or a silicone. Untreated fat is not recommended because it leaves grease spots ("fish eyes") where the glue is applied. (See accompanying table.) One defoamer manufacturer finds that carefully blended compounds, rather than a single chemical like methylsiloxane, make the most effective defoamers. Whether paste or liquid, nonionic or anionic, the blends must be formulated for uniformity, compatibility with glue liquors, lack of "fish eyes," and easy handling. Cost is a factor too, especially with silicone, but even a silicone blend proves economical in the long run if it solves a difficult foam problem.

Of the variety of liquid and paste products available, no one defoamer functions well in all glues or in all glue applications. Glue users must consider the composition, pH, and temperature of the glue, on the one hand, and the concentration of the defoamer, on the other. Some foam conditions require less than one per cent of defoamer; very persistent cases, five per cent. Excessive amounts, however, are likely to foster the development of foam, instead of reducing it.

Defoamers are added in liquid or emulsion form to the glue. Liquid products can be used as is or emulsified in twice their weight of water, whether the glue is dry or in solution. Paste products are always dispersed, either in hot glue solution or in hot water (130-165°F.). The

Ingredients And Applications Of Defoamers

Chemical Type	Example	Applications
Alcohols	Octyl alcohol Nonyl alcohol Amyl alcohol Caprillic alcohol	Animal glues, gelatine; papermaking, fermentations, dye and electroplating baths; aqueous distillations, soap manufacture, varnish products, photographic and ceramic industries
Fatty acid esters	Ethyl acetate Isoamyl isovalerate Glyceryl monostearate Polyalkyl glycols and derivatives Polyamides	Glue and yeast production, protein and hydrocarbon solutions, latex paints, paper coating, food processing
Silicones	Methyl polysiloxane fluids Methylsiloxane containing finely divided silica	Adhesives, soaps, lubricating oils, vegetable and animal fats and oils, tar, asphalt, rubber and latex processing, paint and paper production, leather and textile finishing, polishes, waxes, resins
Sulfates, sulfonates	Sulfonic acid salts Alkali metal salts of sulfonated alcohols	Hide and bone glues; papermaking, yeast fermentations, petroleum production

latter method, known as "pasting in," consists of stirring into the paste small amounts of water until the water's weight is twice that of the defoamer. This can be done by hand or in a defoamer emulsion tank resembling the Acumeter (the smallest of which handles 0.91-5.46 pounds of defoamer per hour). If the tank is mechanically equipped for stirring and heating, the correct ratio of defoamer and water is simply charged, warmed, and stirred until the emulsion is uniform. While heat from a closed coil is permissible, an open steam pipe should never be used.

Defoamer Addition Methods

Methods of adding a defoamer to glue include pouring, flicking, or spraying. Liquid agents may be poured or flicked into a glue solution, if desired. When the glue is dry, however, and the defoamer is emulsified, an air-pressure spray gun is recommended. The emulsion is sprayed onto each of several layers of dry glue. The layers are then ground in a mill with just enough hot water to fluidify the defoamer. Water is easily kept to a minimum if the spray gun is used in connection with an emulsion make-up tank. In this set-up, the defoamer is kept hot by steam passing through a copper tube coiled about the iron feed line.

When the glue is in concentrated solution, an emulsified defoamer can be run directly into it if the emulsion tank is located just above the glue storage tank. The storage tank receives the glue from the last evaporator, mixes it with the defoamer, and passes it to the refrigeration system ("pearler" or cold sheet extrusion type).

Difficult Foam Problems

Despite all precautions, glue firms do have foam difficulties that sometimes defy solution. These are situations where the defoamer manufacturer can supply invaluable assistance. A technical staff, experienced in blending defoamers for specific uses, can test a given defoamer by duplicating plant conditions in the laboratory. If necessary, representatives visit the plant for on-the-spot analysis of the foam condition. Using these methods, defoamer specialists can fix the cause of the foam problem and determine its remedy.

In laboratory and plant evaluations of defoamers, various tests are used. Some customers try out glue defoamers by bubbling air through a sintered glass diffusion plate while vigorously agitating the glue solution. Others use gas dispersion equipment which requires volumes of test solution. One user runs two hot drying tests for defoamers in glue solutions: in the first, a 30 per cent glue solution is dried at temperatures ranging from 80-160°F. over a five-hour period; in the second, the solution is diluted to 12.5 per cent solids and dried at 104°F. More common, however, are the eggbeater and Oster mixer tests.

The eggbeater foam test is used as follows by one of the largest glue compounders who markets a typical blend of glue containing diluents and plasticizers such as Epsom salts and sugar. A solution of water (1.25 parts), blended glue (1 part), and 1 per cent defoamer based on dry glue is heated to 140°F. and stirred with a kitchen eggbeater for 50 seconds. The mixture is then allowed to stand while the appearance on its surface of a dime-sized clear spot is timed and recorded. The foam should break within 25 seconds.

Oster Apparatus

The Oster mixer test is preferred by a company manufacturing a wide variety of paste and liquid defoamers. The Oster apparatus is equipped with a hexagonal knob in place of an agitating blade. The test solution consists of 200 grams of a 10 per cent glue solution and a defoaming agent at 1, 2, or 4 per cent based on the weight of the glue. After marking the level of the liquid in the inverted jar, it is agitated for 10 seconds and allowed to settle for another 10 seconds. The height of the foam is measured and recorded at that time and again after three minutes.

Conclusion

The extent to which chemical companies and glue users test the performance of defoamers illustrates their significance for the glue industry. It should be pointed out that the control of foam is equally vital for the paper, textile, and paint fields.

Those chemical houses, therefore, which devote considerable time to the research and development of better defoamers are playing no small part in answering the needs of modern industry.

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Notes: Acumeter is a trademark of Acumeter Laboratories, Inc.; The Oster mixer is produced by the Oster Mfg. Co.

The photograph used in this article is through the courtesy of Morningstar-Paisley, Inc.

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Fish Glue A By-Product of Nature

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About the Author

HUGH C. WALSH, product manager in industrial adhesives at LePage's Inc. since 1954, is now employed in the same capacity at Permacel, Inc. He is a graduate of Northwestern University, holding a B.S. degree in chemical engineering. During World War II, he served in the U.S. Air Force.

The art of making and using glue from fish skins dates back to the ancient Greeks and Romans. At that time, fish glue was used for a variety of purposes ranging from furniture making to adhering precious stones in settings. Fish glue was not used again until 1876 when William LePage, a Boston tinware manufacturer, and Reuben Brooks, a native of Gloucester, Mass., developed a modern process of making glue from codfish skins.

The availability of cod skins was made possible by new processes for preserving and selling fish. From its founding days, the fishing industry had prepared the cod, which were brought into the port of Gloucester, with skins intact. After the Civil War, however, salt codfish were prepared and sold in packages after the skin and bones had been removed. As a result of this new marketing change, fish skins were available for which there seemed no ready use. This waste product was utilized by LePage and Brooks as the base ingredient for their fish glue, which is also referred to as liquid glue and Russia Cement.

The name Russia Cement stems from an association of fish glue and leather belts from Russia. At a time when leather belting was used extensively to transmit power to pulleys, a strong glue for splicing these belts was needed and fish glue was found to be ideally suited for the job. Since Russia was the source of supply for fine leather belting, the name Russia Cement evolved.

Research studies showed that cod skin was the best suited fish skin available for the making of fish glue. Factors such as high quality, uniformity and large raw stock yield proved conclusively the superiority of cod skins over other types of fish skins.

Cod Skin Still Used

Even to this day, with cod no longer in abundance in the sea near Gloucester because of warmer water temperatures, cod skins are still exclusively used for the manufacture of liquid fish glue. These skins are imported from Nova Scotia, Greenland and Iceland, further attesting to the importance of cod as a raw material for glue.

The ingredients and methods of processing of fish glue are practically unchanged from the original glue-making days of the 1870's. True, improvements and innovations in equipment, packaging, storage, etc., have evolved and the glue industry has kept pace with general industrial advances. However, no better fish skin than the cod has been discovered and rigid adherence to careful, deliberate processing, inspection and quality control has enabled fish glue to maintain its place as one of the leading adhesive products in use today.

This is indeed an enviable record when viewed in the light of the many "modern" synthetic adhesives recently developed and the many other types of natural adhesives available. More important, there are the innumerable synthetic materials which we have seen come into being in our lifetime which require an adhesive as a bonding or holding agent.

Any adhesive product held in such high regard by modern industries must have unique qualities and properties. Fish glue has attained and held its rank in the adhesives field because of its stability and versatility. Its multiplicity of outstanding qualities permits use of the glue in a number of diversified industries.

Fish glue being applied to a furniture joint. It is the principal adhesive used by the furniture and cabinet making industries.

One of the first industries to adopt fish glue as a major adhesive was the furniture and cabinet making. The happy association lasts to this day, since fish glue is still the principal adhesive used by these skilled craftsmen. The popularity of fish glue in these industries is due in great part to its high joint strength with the advantage of reasonable open time to permit assembly of multiple components.

Gummed tape manufacturers use fish glue on veneer splicing tapes, glass reinforced tapes and high strength tapes. The glue is added to the formulation because of its hard sticking quality to difficult surfaces such as wood, metal and glass. It is used on carton sealing tape because of its high initial tack on remoistening and the longer open time it allows to align tape properly.

Use in Paper Tapes

High heat resistance makes fish glue an excellent adhesive for paper splicing tapes where splices must withstand the high temperatures of drying ovens.

Fish glue is used extensively in the shoe industry where high initial tack in the wet state is needed for temporary holding, combined with a permanent bond when the glue is dry. It is also used for making shoe boxes and covers.

In the envelope industry, fish glue is added to the dextrine adhesive used on remoistenable seals. It improves remoistenability and adhesion to hard sealing papers.

Industrial finishers make use of fish glue in finish formulations because of its high pigment suspending power, its action as a binder, and high heat resistance which allows plating or baking of the finish on the article to which it is applied.

The adhesives industry itself uses fish glue in the manufacture of other adhesives. An excellent tackifier, fish glue is fully compatible with some polyvinyl acetate emulsions, dextrines, and latex systems.

Paper box makers rely heavily on fish glue for make-ready and for adhering pressed board to steel. The glue can be washed from steel readily with water when a new set-up is required.

Among the derivatives of fish glue are several products used in the graphic arts field. With the addition of bichromates, highly refined fish glue can be rendered photosensitive. This has led to the development of Photoengraving Glue, Prepared Glue Top, and Printed Circuit Resist.

Photoengraving Glue is the base material used to make a photosensitive coating for metal printing plates. The photoengraver adds water and ammonium bichromate to the Photoengraving Glue to render the solution photosensitive. The metal printing plate is flowed with the solution and the glue is dried to a film. The plate is printed, developed and dried. At this point, areas of the metal are exposed while other areas are protected by the glue solution. The plate is immersed in an etching solution where the metal is dissolved in the exposed metal areas and remains unchanged in the areas protected by the glue solution. Thus, images with printing depth are made on the metal plate.

Prepared Glue Top is used as a photosensitive coating and "resist" to the etching solution. The Prepared Glue Top is ready for use and stabilized to prevent deterioration.

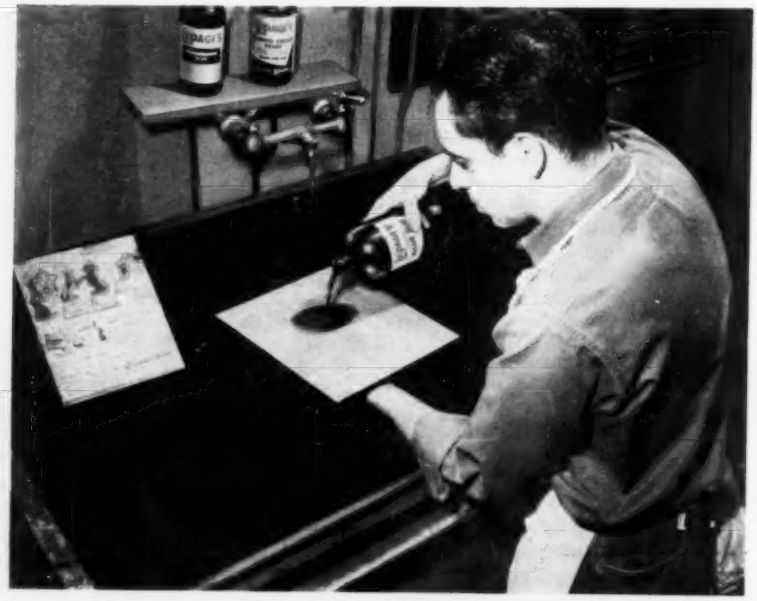
Printed Circuit Resist has been developed as a prepared photosensitive coating and resist for use in the manufacture of printed circuits. Because of its ability to reproduce minute detail, Printed Circuit Resist is ideally suited to the ever-increasing demand for miniaturization in printed circuits in the electrical and electronic industries.

Much of the romance of the sea, so long associated with fish glue, is gone. The bold sailing ships have given way to commercial fleets with the latest gadgets and comforts.

The romance of the product itself, however, continues to fascinate everyone who uses it and diligent research is uncovering new uses and adding glamor to another by-product of nature—fish glue.

Outstanding Features of Fish Glue

- **High bond strength**
- **Affinity for most materials**
- **Excellent wood glue**
- **High heat resistance (400°-500°F.)**
- **Good dielectric properties**
- **Neutral pH**
- **Freeze-thaw stability**
- **Excellent binder**
- **High pigment suspending power**
- **Excellent cold resistance**
- **Low toxicity**
- **Pleasant odor in liquid form**
- **Odorless dry films**
- **Dry film reactivated instantly with water**
- **High wet tack**
- **Good solvent resistance**



Among the derivatives of fish glue are several products used in the graphic arts field. Above, a photoengraver is pouring Prepared Glue Top, a fish glue derivative, onto an engraving plate to act as a "resist" to the etching solution.

Operating view of a modern ball bearing 60-gallon cold adhesive mixer. The operator is seen adding either water or a liquid catalyst to the resinous mix.

development and mixing of Resin Adhesives

By **JOHN E. HYLER**

John E. Hyler & Associates,
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Somewhere between 1905 and 1910, a chemical discovery was made which led to development of phenol-formaldehyde resins. This discovery, made by Dr. Leo H. Baekeland, was first exploited in the form of plastics. Specifically, Dr. Baekeland found that by using ammonia as a catalyst, phenol and formaldehyde could be combined and reacted together in such a way as to produce a very heavy liquid. He found that by subjecting this liquid to further heat, it would suddenly cure, forming an extremely tough and hard material, completely insoluble thereafter. Out of this discovery grew the modern plastics industry.

Many years elapsed after this initial discovery before phenol formaldehyde resins began being used as adhesives, chiefly in the plywood field. The first-discovered material was definitely heat-reactive, and the idea of using hot plate presses for plywood bonding was still an unfamiliar concept. Not until after blood-albumin glue had first pioneered as a thermosetting adhesive did the idea of using phenol formaldehyde resins for the purpose at hand begin to be seriously entertained.

In manufacturing these resins for use as adhesives, they are cooked in kettles through the initial stages of reaction. Careful control is exercised, so that the reaction can be halted, by cooling, at a carefully predetermined point. After this primary preparation and cooling, the resin can have an appreciable length of storage life before it is actually used as an adhesive. Varying methods of control employed by different manufacturers result in production of different adhesives with varying lengths of potential storage life.

Note: Photograph courtesy of Black Bros. Co., Inc.

Phenol Formaldehyde Adhesives

Although variations exist in the particular manner in which different manufacturers of phenol formaldehyde resins prepare their adhesives, the general method consists in putting phenol and formaldehyde together, in approximately equal proportions, in a huge kettle and adding a catalyst. Often, caustic soda is employed as the catalyst. An initial reaction occurs in which heat is given off rapidly. After this, the resin solution is boiled until it reaches a proper condition for use as a liquid resin. Nevertheless, it may be and often is converted to resin powder by means of a spray drying process. When converted to powder it has longer storage life.

Various other types of resin adhesives have been developed and placed in relatively wide use since that time, some of them at room temperature. Resorcinol-formaldehyde resins are a specific branch of the phenolic type which were developed later. Urea resins, lower in price, have come into exceedingly wide use. Melamine-formaldehyde resins constitute another branch of adhesives, similar to the ureas. These have certain advantages over urea adhesives. Polyvinyl resin adhesives have also come into existence and are used to a considerable extent for bonding molded plywood components.

Resin glues have characteristics distinctively their own and operators soon learn to handle them accordingly. For instance, high temperatures existing in summer are known to shorten considerably the working life of resin adhesives in general. This, in turn, may cause related difficulties, such as hardening in the grooves of spreader rolls, solidifying in mixers or containers, etc., making it necessary to mix adhesive more often. Nevertheless, such difficulties can often be largely eliminated by watching mixture temperatures and keeping them as low as is consistently possible.

Cooling Resin Adhesives

Resin adhesives may be cooled, particularly before mixing in the catalysts, and the mixture kept cool while using. Automatic refrigeration *may* be used for keeping the temperature down. Occasionally, the mixture is placed in buckets and these buckets are placed in larger containers having ice in them. Where neither ice nor refrigeration is available, buckets of adhesive may be kept in tubs of cold water. It is seldom advisable, however, to reduce the adhesive's temperature below 60°F. It will then become much more viscous, and difficult to spread.

It is also to be remembered that resinous adhesives are definitely exothermic; heat is liberated as the bonding agents are mixed. Consequently, cold adhesive mixers provided for this purpose by leading manufacturers (such as Black Bros.), are provided with a water jacket when desired. This is particularly important, especially when large batches of resin adhesive are being mixed. Practically all of the resins have mixing qualities which are more satisfactorily developed at some specific temperature which is often specified by the manufacturer.

Employment of a water jacket around the mixer provides means for proper control. This allows cold water to be circulated through the jacket at a desired rate, to cool the batch and prevent it from getting too warm, thereby losing part of its pot life. Cooling the adhesive at the time it is being mixed, then employing a spreader fitted with water-cooled doctor rolls, makes it possible to extend pot life of some adhesives from ¾ hour at 100°F. to as much as 4 hours of additional working life in surroundings where an approximate temperature of 70°F. can be maintained. With this in mind, a water jacket on a mixer used for resins effects sufficient economy to justify its initial coat.

About the Author . . .

JOHN E. HYLER has had years of experience with adhesives in the woodworking, veneer and plywood industries. His study of the subject began at a time when only animal glues were available in this country and has continued until the present. He is the author of a great many articles on the subject. One of his major projects was a series of articles on glues and gluing which ran to 98 parts, concluding in the Christmas, 1956 issue of SOUTHERN LUMBERMAN.

What's New In—

Box and Label Adhesives

Vital to every glamorous box or smart label, but unseen and usually unappreciated by the consumer who buys it, is the adhesive that holds the box or bag together or sticks the label to the can, bottle, or jar. As the Adhesives Manufacturers Association of America points out, "No package is stronger than its seal. Without the numerous special formulations of adhesives, today's glamor materials of packaging would be useless."

Adhesives are back of such packaging forward-strides as the boilable cook-in-bag packages; laminated film-and-foil combinations; thermo-sealed cartons; labels that stick to glass despite moisture, heat or cold; waterproof shipping containers that withstand the rigors of Arctic or tropical climates. Not only in the package itself but in the high-speed machine that makes it, precise formulations of adhesives are indispensable to top performance.

Four Adhesive Classes

Four major categories of adhesives serve the packaging industry. Those based on starch—mostly from corn, in minor degree from potatoes and tapioca—account for about 50 per cent of all packaging-adhesives productions. The synthetics, based on polyvinyl resins and other substances, make up about 40 per cent of the total. The remaining ten per cent includes such specialties as animal glue, fish glue and casein, as well as the mineral-based adhesives.

Formulating an adhesive to seal a package is something much more than cooking up a pot of glue or paste. New packaging materials demand adhesives with specific characteristics. Precise calculations on such factors as flow, tack, temperature range, setting speeds, bonding and aging properties, require technicians of a high degree of skill. A thorough knowledge of the chemistry and physics of adhesion is a prime requisite for the technical staffs of adhesives-manufacturing firms.

Such skill and knowledge are by no means confined to the adhesives makers themselves. The suppliers of the raw-material bases—the manufacturers of corn starch, for example—must be fully informed on adhesive requirements. Pastes, glues and gums based on corn starch and its derivative, dextrin, are used for carton sealing, can and bottle labeling, envelope-flap gumming, paperstock lamination and scores of sticking jobs in non-packaging fields. Many types and modifications of corn starch are tailor-made to meet the various and often minutely different requirements of a multitude of users.

Military Specifications

Military specifications for starch adhesives are numerous and exacting. The boxes and cartons of the Army and Navy must stand up to the toughest kind of handling and protect their contents in desert heat or polar cold. If corn starch served no other defense function (actually it serves hundreds), this one alone earns it a place high on the list of essential military goods.

Despite their basic role in packaging, adhesives represent a minor fraction of the cost of making containers. Annual sales of adhesives to the packaging industry are running currently at about $109 million, according to Department of Commerce figures and trade estimates. Thus, adhesives represent only seven-tenths of one per cent of the $15 billion annual cost of wrapping up the wares of American manufacturers. The family of four, paying $352 a year for packages, pays only $2.46 for the adhesives which make the packages possible.

Price vs. Quality

A member of A.M.A.A. recently observed that, considering this almost infinitesimal proportion of total package cost, the packager who attempts to trim his budget by buying adhesives on price rather than on quality is exhibiting an extreme form of penny-wisdom and pound-foolishness.

From Abroad:

A Report on British Adhesives

Use of new chemical and petrochemical materials in adhesives increases the range of their industrial applications

Although adhesives have been known and used for generations, the widespread increase in their use has arisen in large measure from the availability of new materials produced by the chemical, and especially the petrochemical, industry. These novel raw materials have made it possible for the adhesives manufacturer to offer new adhesives having properties and applications well outside anything previously considered possible for the traditional adhesives.

Among the manufacturers of such adhesives is Surridge's Patents Ltd., Beckenham, Kent, England, who have been engaged in the manufacture of adhesives for half a century.

Starting with the supply of natural rubber solutions, intended mainly for the automobile and footwear industries, Surridge's has continually extended its range so as to take advantage of the potentialities of new materials and to widen the field of application of adhesives.

Range of Products

The range of the company's products includes two adhesives of special interest, Titebond 22 and Holdtite 33. Introduced about eight years ago Titebond 22 can be used for bonding all kinds of fabrics, wood, leather, paper, glass, porcelain, metals, and all kinds of plastic material.

Applied by brush, dipping, roller coating or spray, it gives permanent joints which stand up to a wide range of service conditions. Examples where it has been successfully used include tinplate to aluminum, resin impregnated paper to metal, phenolic sheeting to metal sheeting, fabric to phenolic mouldings, copper foil to laminated phenolic resin, polyvinyl chloride sheeting to wood, felt to metal, and cork sheeting to metal.

Storage Feature

A particular feature of this adhesive, making for ease in production, is that parts can be coated with the adhesive, allowed to dry, and stored until required. When the parts are to be joined together, the adhesive film can be reactivated either by means of a solvent or by heat, and good joints may usually be obtained without further application of adhesive.

Holdtite 33, introduced more recently, also has a wide range of application. Rigid phenolic and PVC sheeting, PVC coated fabrics and leather may be adhered to each other and also to hardboard, aluminum and other metals, linoleum, wood and concrete.

A particular feature of No. 33 is its immediate high initial tack. This enables large sheets such as those used in the building industry, to be readily fixed in position. The initial strength rapidly increases so that exceptional bonds are obtained. The joints have excellent resistance to moisture and elevated atmospheric temperatures. The extended tack life allows ample time for the preparation of the work pieces and the high wet strength of the bond eliminates any need for clamping or the prolonged application of pressure of any kind.

Surridge's also produces a line of general purpose cements which are used in plants where it is desirable to use a single cement for many purposes. Among the applications for which the general purpose cements are suitable is the adhesion of rubber to concrete; rubber to wood; linoleum to wood; linoleum to metal; leather to rubber; leather to chipboard; polyurethane foam to metal; latex foam to metal; rubber to metal; fabric to wood; fabric to metal; linoleum to card; chipboard to paper; polyurethane foam to wood; latex foam to wood; and rubber to fabric.

Diversified Consumption

The company's line of adhesives are used by the aircraft industry, boot and shoe industry, car manufacturers, clothing industry, flooring applicators, furniture industry, interior decorators, photographers, advertising agents, commercial studios, plastics industry, printers, rug and carpet manufacturers, ship and boat builders, and upholsterers.

Fixing together two components is one of the fundamental features of manufacturing industry. As a result of continuous research it is possible today to use adhesives in many cases where nailing, screwing, bolting, riveting or sewing were previously considered the only practical methods.

Corrugated board output speeded and costs cut through use of a

Double-Duty Starch Paste

By **JOHN D. GRIFFIN**
Plant Manager
Old Dominion Box Co. Inc.
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and **EDWARD H. HILL**
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By switching to a low solids paste which uses a double-duty starch in both the carrier and the slurry, Old Dominion Box Co., Inc., is producing more uniform corrugated board on machines running at higher speeds. The production speedup at the company's Charlotte, N.C., plant required no change in operating conditions and resulted in a bonus saving of 20.7 per cent of starch cost.

The new paste formulation relies on a single thick-boiling starch of the pearl type. In the previously employed paste process, both thin-boiling and thick-boiling modified starches were required. Containing about 16.5 per cent total solids, 3.5 per cent less than the type discarded, the new paste is more stable in viscosity and has better tack for quicker drying.

Wholly Integrated Plant

Employing over 500, the Charlotte plant is one of the first wholly integrated plants in the industry, and houses all box-making operations under a single roof. As a result of the paste change, its recently installed 85-inch corrugator is able to operate at a higher speed with no alteration in drying conditions. In addition, other plant operations have profited from an improved board production which has resulted in a higher Mullen, fewer highs and lows, and less warping and wash-boarding.

A recent three-day mill trial, during which 42-pound 200-test board was produced using both the new and old paste processes, provided a striking demonstration of the fast production and improved quality obtainable with the low solids paste. Because it dried more quickly, board made with the new paste was better bonded and less likely to crack on the sides. Control and even distribution of moisture throughout the board discouraged any tendency to warp.

The improved board was flatter and made for easier printing, cutting and scoring. With all plant operations benefiting from these changes, far less board had to be scrapped.

In making corrugated board at Charlotte, kraft paper is corrugated by steam-heated flute rolls; adhesive applied to the tips of the corrugations on one side; a paper liner is brought into contact with the adhesive-coated tips, and the bond formed by heat and pressure. This is done on the corrugator or single facer.

Next, adhesive is applied to the tips of the exposed corrugated surface, another liner brought into contact with the corrugations, and the bond again formed by heat and just enough pressure to hold the liner in contact without deforming the corrugations. This is done on the double backer.

Since too much pressure in bonding might crush the corrugations, getting a strong bond has always been a difficult industry problem. Enough adhesive must be applied to insure good contact between tips and liner, and the board must be heated to cause the adhesive to set up rapidly. When the board passes from the double backer part of the corrugating machine to the cut-off knife, the adhesive bond must be set up enough to hold the liners and corrugations together so the board can be cut into sheets and stacked.

Francis mixer being filled with starch. Most unusual step in the new paste process is the addition of borax to the mixer before the caustic.

In the starch process, the adhesive is applied to the tips of the corrugations and then, after the liner is in contact with the tips, heat is applied, and the starch cooks or gelatinizes *in situ*. Once gelatinization occurs, an extremely heavy bodied paste develops. This paste is stronger than the paper fiber and a permanent bond forms almost instantly.

A saving of 3¢ to 5¢ per 1000 square feet of two line board has been obtained with the new paste which requires about 20 per cent less starch. In a single day, Old Dominion ran 1,300,000 square feet of board, using 2140 gallons of new paste containing only 1.3 pounds of starch per gallon. This compared with a previous daily output of only 770,000 square feet of board, using 1250 gallons of the old paste with 1.6 pounds of dry starch per gallon. Naturally, in this comparison allowance must be made for the kind of board being run, as well as the type of paste used.

One typical day's run with the new type paste showed a saving of $53.65. Total starch costs that day for the new paste were $207.50, compared with $261.15 for the old starches.

Additional Savings

Another source of savings made possible by the new paste process is the closing of the glue rolls that apply the paste to the tips of the corrugations. The closer the pick-up roll and doctor roll are to each other, the thinner the film of adhesive applied. Because of its greater tackiness and faster drying, the low solids paste gives more effective bonding. Hence, less adhesive is required, and a thinner film can be used.

At Charlotte, the glue rolls on the single facer have been closed up from 0.013-0.014 inch to 0.012 inch. Rolls on the double backer have been closed from 0.009-0.010 inch to 0.008 inch.

Mill trials at the plant have convinced Old Dominion's management and Corn Products starch experts that a viscosity between 40 and 50 seconds is best for efficient operation. However, quality board has been produced successfully by using paste with viscosities ranging from 28 to 100 seconds.

Using the low solids paste at these widely varying viscosities, the machine was able to make good board at a faster speed than was normal with the previous paste formulation.

Since the new paste can thus be safely used over a much wider range of viscosities, the corrugating machine can be run with thick or thin paste without changing the speed of the machine, or stopping to reset the glue rolls. This is particularly advantageous in starting up after weekend shutdowns when the paste has thickened.

Technicians peering into the Francis mixer at heavy paste made by the new low solids formulation. The mixer has two-way agitator driven by 5 hp. motor, with powerful blades rotating in opposite directions at 80-90 rpm.

The new low solids paste is extremely stable in viscosity at the same temperature. It has little tendency to thicken, nor does mixing make it much thinner. Paste in the slurry tank at Charlotte increased from 43 seconds to 44 seconds after three hours, a gain of only 1 second. Even prolonged mixing does not break down the viscosity of the product appreciably.

In another test at Charlotte, a high viscosity paste made by the new low solids formula was agitated for 20, 40 and 60 minutes in the lower mixing tank. The corresponding viscosities were 83, 78 and 75 seconds, showing very little breakdown and demonstrating the exceptionally stable viscosity of the new paste. Best of all, since agitation over a long period has so little effect on viscosity, little or no stabilizer need be added to the low solids paste.

Unique Characteristic

Unique characteristic of the new formulation is its stringiness and improved tack when the raw starch in the paste is gelatinized by heat on the machine. Its tack depends in large measure on its effective alkalinity, which makes it thicken quickly when heated and also enables it to penetrate or bite into the board.

Because of its tackiness, the new paste sticks and dries quickly. As a result, it sets more rapidly under the influence of heat and moderate pressure, providing an exceptionally strong bond between the tips of the corrugations and the liner.

Since it dries faster, bonding prevents the liner from pulling away from the corrugations. Moisture is removed uniformly throughout the entire surface of the board, and warping is therefore virtually eliminated. Since excessive heat is unnecessary, the board does not curl because of overdrying.

At Charlotte, temperature in the preheaters, corrugating rolls on the single facer, and hot plates on the double backer is thermostatically controlled. For gelatinizing raw starch in the paste on the machine it is kept between 320-330°F. Steam for heating is at about 100 psi. Finished board has a uniform moisture content of six to eight per cent.

Two Paste System

Old Dominion currently employs a two paste system in which separate pastes are prepared for the single facer and the double backer. The gel point of paste for the single facer must be high enough to avoid premature gelatinization in the paste pans, while that for paste going to the double backer can safely be lower since the paste encounters less heat.

To obtain a lower gelatinization temperature, more caustic and borax are added to the paste for the double backer. Slightly more borax than caustic gives the best results.

The gel point for the new low solids paste going to the double backer is about 142°F., that for paste used in the single facer is 147°F., high enough to avoid gelatinizing in the pans. Paste viscosity is 28-34 seconds for the single facer and 45-50 seconds for the double backer.

The low gel point of the paste formulation, which was introduced by Corn Products Sales Co., gives more rapid bonding, and speeds the entire corrugating operation. It is the

better tack and quicker drying of the low solids paste that make higher machine speeds possible in the process.

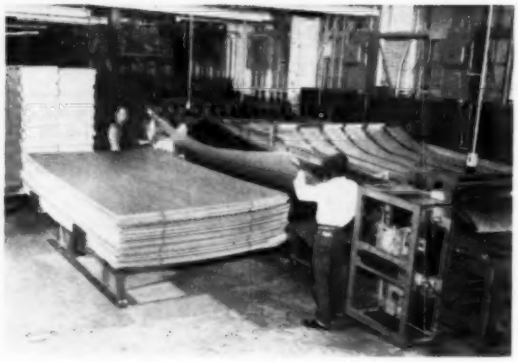
The most unusual step in the new paste process is the method of adding borax. The borax is added before the caustic, and it is added to the primary or upper tank, not to the lower slurry tank as in the conventional process.

This step is crucial. The borax is added after the starch for carrier has been dispersed in water in the primary tank, but before any dissolved caustic has been run into the tank. The contents of the tank are thoroughly mixed, then heated to 160°F., but no higher, and held five minutes. Then the dissolved caustic is added, and agitation is continued. Finally, more water is added, and the paste is ready for the slurry tank.

The novel way in which the borax is introduced in the new process makes it far more effective. Initially, its function is to thicken the carrier starch. However, since it is thoroughly distributed throughout the water dispersion of the carrier starch before the caustic is added, the borax is also free to exert its full buffering action on the caustic when it is added.

Purpose of Caustic

The main purpose of the caustic, of course, is to lower the gelatinization temperature of the starch. It likewise imparts good bite and tack. Once the starch in the paste begins to gelatinize on the machine, the action of the borax greatly increases its viscosity. It also helps to improve tack and bonding.



End of corrugating machine at Old Dominion's Charlotte, N. C., plant, with men handling some large corrugated board. As board passes from double backer to the cut-off knife, the adhesive bond must be set up enough to hold the liners and corrugations together so board can be cut into sheets and stacked.

No new paste making equipment is required. The low solids paste can be made in standard equipment. Old Dominion, for example, uses the familiar 333-gallon Henry Pratt unit, which can actually be used to prepare 350 gallons of paste per batch. The new paste can be made just as fast as the previous paste.

How the Paste is Made

Here's how the new low solids paste is made at the Charlotte mill. Ninety-three gallons of water is run into the upper primary tank or Francis mixer. This brings the water level to within 13 inches of the top. Next, 100 pounds of starch for the carrier portion is added.

If paste for the single facer is being made, 15 pounds of borax is added to the water dispersion of carrier starch. If paste for the double backer is being prepared, 16 pounds of borax is used.

At this point, the two-way agitator, which is driven by a five-hp. motor and has powerful blades revolving in opposite directions at 80-90 rpm, is started, and the steam for heating is turned on. The contents of the Francis mixer are heated to 160°F. and held five minutes. It is highly important that the steam be cut off at 160°F. to prevent undue thickening.

Adding the Caustic

Next, if single facer paste is being made, 14½ pounds of caustic dissolved in water is added to the primary tank. In preparing paste for the double backer, 16 pounds of caustic is used to get a higher viscosity and lower gel point. After all caustic has been introduced, agitation is continued for 15 minutes.

Water is added to the primary tank to bring the level to within five inches of the top of the tank. This brings the total volume to 126 gallons. After the water has been added, the carrier paste is ready to be pumped to the lower slurry tank. Because of confined headroom in the Charlotte mill, it is not feasible to drop the contents by gravity as is usually done in the process.

Meantime, the lower slurry tank has been filled with water to within 17 inches of the top, a total of 210 gallons, and 400 pounds of raw starch added with continuous agitation. The horizontal agitator in this main slurry tank has four propellor blades and rotates at 500-550 rpm.

Single facer shown running with operators on the job. This rapid bonding speeds the entire corrugating operation.

Final Procedure

When the raw starch has been dispersed, the carrier paste is pumped quickly from the top tank into the lower slurry tank. Agitation is continued, and 1 quart of formaldehyde is added. The level in the bottom tank now comes to within 5½ inches of the top, making a 350-gallon batch of paste.

Finally, the paste is mixed for 15 or 20 minutes to get the required viscosity. Paste for the single facer should have a viscosity of 28 to 34 seconds, that for the double backer 45 to 50 seconds. The finished batch totals 350 gallons of paste at about 16.5 per cent solids.

While Old Dominion uses a two paste system, the low solids paste process can just as readily be adapted to a single paste system. In this system, still used in many corrugating plants, the same paste is employed for the single facer and the double backer.

Note: The special starch mentioned in this article is designated as Number 3123, and is offered by Corn Products Sales Co.; the paste mixer is a product of Henry Pratt Co., Inc.

About the Authors . . .

JOHN D. GRIFFIN, manager of the Charlotte, N.C., plant of Old Dominion Box Co., Inc., has been with the company for 25 years. He was born in Lancaster County, S. C., and educated in South Carolina schools. Since 1932, he has resided in Charlotte. His hobby is fishing, and he is active in the Associate Reformed Presbyterian Church of Charlotte.

EDWARD H. HILL, Corn Products technical representative to the pulp and paper converting industries, has been with the firm since 1946. He is a graduate of William and Mary College with a B.S. degree in chemistry and biology. He formerly was with West Virginia Pulp and Paper Co., as a chemist, and North Carolina Pulp Co., as chief chemist and technical director.

Jewelers Use Adhesives Too

Newly developed adhesive replaces solder

Faced with the problem of permanently mounting metal ornaments on various types of material, L. G. Balfour Co., manufacturer of insignia, trophies, award plaques and fraternal jewelry, is constantly on the alert for new quick-setting adhesives. Company production personnel were, therefore, among the first to obtain test samples of the new Eastman 910 Adhesive.

Within a short time, a series of experimental production setups had established the fact that Balfour now had available an adhesive material which eliminated many assembly problems. For example, medallions of various kinds could now be set on cuff links, jewelry boxes, leather goods, pendants, and many other items requiring careful hand mounting. What's more, the Eastman adhesive was virtually instantaneous, as compared with the cements and adhesives previously used.

The latter feature turned out to be a factor of tremendous importance in meeting special orders requiring fast production and delivery. The production department soon reported that with the new adhesive they were able to save up to 15 hours of processing time.

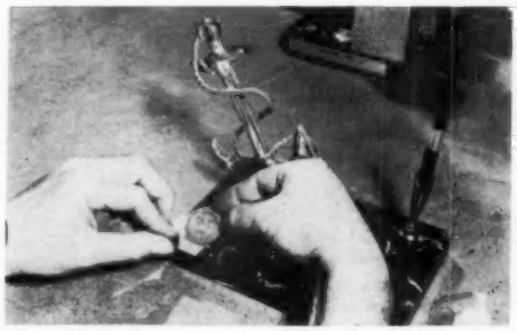
A particularly good example of Balfour's use of Eastman 910 is the assembly of a pen desk set featuring an onyx base on which is mounted an ornamental metal device. A drop of the adhesive is placed on the base and the assembler presses the medallion into place with the aid of a corner plate.

The guide is important since once the medallion is placed on the onyx base it is set almost immediately and cannot be moved. During the original experimental testing, attempts were made to remove the metal device and it was found that the bond was substantially stronger than the onyx itself.

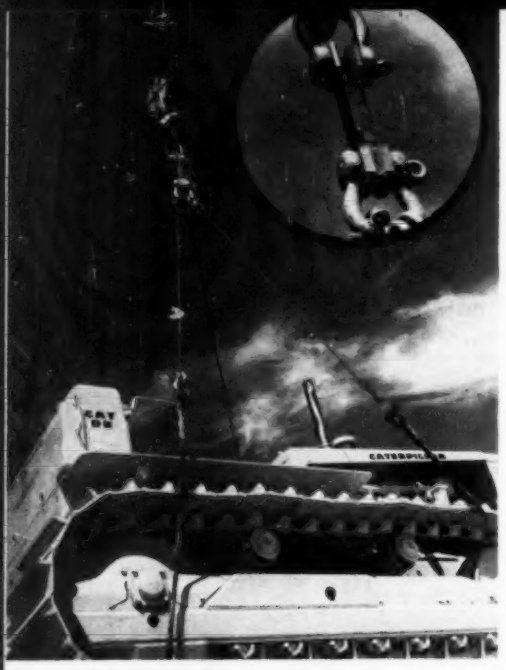
In new production techniques, Eastman 910 is now employed in many cases where solder was formerly employed. This is particularly true in the case of lacquered mountings where it is believed that the adhesive dissolves the lacquer and produces a permanent bond between the mounting and the metal surface to which it is attached.

In the course of some office and lobby remodeling work, experiments were made in the use of the adhesive for bonding Formica paneling on walls and counters. First, tentative use of the adhesive was made in a single area where the Formica was bonded to a plywood base.

Because in some instances the Formica was to be mounted on curved surfaces, quick adhesion was essential. Results in the trial area were so successful that it was decided to use the adhesive throughout the project.



Adhering metal to onyx with Eastman 910 Adhesive.



A 44,000-pound tractor is suspended from three steel plates (see inset) bonded together with one-quarter ounce of aircraft-missile adhesive.

Jet Age Adhesives

Aircraft adhesives find wide application in industry . . . . .

Modified versions of ultra-strong aircraft adhesives originally developed for bonding critical aircraft and missile components are being rapidly adapted for a growing variety of industrial applications.

Reported to be among the strongest bonding agents ever perfected, these modified adhesives are nevertheless almost as easy to use as ordinary glues. Their substitution for mechanical fastening techniques used in some mass-assembling operations has both cut costs and improved product appearance.

For example, Francis Brothers Corp., Tustin, Calif., recently ran a series of production line tests on the effectiveness of adhesives in assembling aluminum screen doors. The results showed that in switching from screws to adhesives they not only eliminated expensive and time-consuming drilling and tapping operations, but wound up with a stronger, better looking door. In addition, they were able to bypass the problem of door sag caused by the loosening of corner screws.

Door Assembly Technique

In the simplified door assembly technique adopted by Francis Brothers, side and top rails are accurately cut with 45° bevels, from hollow extruded aluminum stock. The corners are then assembled by coating an especially shaped section of an aluminum extrusion with Narmco Formula 3135 and fitting in the rails at the corner joint. Completed units are then stacked, without clamping, and the adhesive is allowed to cure.

One reason for the industrial popularity of aircraft adhesives is their extreme versatility. When hard, they may be drilled, tapped, machined, sawed or filed. As a result, in addition to regular gluing applications, they are useful for puttying and filling in voids or breaks in castings or other metals. Because they form a virtually indestructible surface that is resistant to wear, oxidation, and most chemicals, they are also used as protective coatings on metals.

Tremendous Holding Power

The tremendous holding power of small quantities of aircraft adhesives was dramatically demonstrated recently when a 22-ton tractor was suspended in air from three steel plates that had been bonded together with just one-quarter ounce of adhesive.

As newsreel and U.S. Air Force cameras ground away, the sky-borne tractor dangled safely from the plates which had previously withstood twice this load in laboratory tests.

Clifford W. Brown, president of Narmco Resins & Coatings Co., a pioneer in aircraft-missile adhesives, points out that the amazing strength, versatility, and ease of use of these new bonding agents were contributing factors in the decision to adapt them to consumer requirements. "They produce such strong bonds with metals, woods, plastics, and glass," Mr. Brown notes, "that they promise a breakthrough for the weekend craftsman as well, allowing him to undertake jobs that are impossible with ordinary cements."

According to the Narmco executive, these bonding materials differ from animal and casein glues, which use water as the liquefying medium, and "airplane cement" type adhesives, which employ highly volatile, inflammable liquefying agents such as acetone.

Aircraft adhesives are packaged in two-part, liquid form and the ingredients are mixed just before use. Internal chemical action is all that is required to cure the bond line.

Note: Narmco Formula 3135 is a product of Narmco Resins & Coatings Co., Costa Mesa, Calif.

Aircraft-type adhesive is applied to corner joints of screen doors in mass-assembly technique used by Francis Brothers Corp.

Clean Up With Adhesives

An electronic air filtering system employs adhesives for trapping dust

A newly available detergent-adhesive product now makes it possible to operate sensitive electronic air cleaners at their maximum potential efficiency. It accomplishes this by skillfully combining cleansing and adhesive coating functions into one.

As determined by the National Bureau of Standards Dust, Spot Test, a true electronic air cleaner will remove 85 to 95 per cent of all airborne particles. Much of this efficiency is often lost, however, because the washing system cannot do an effective job of keeping the collecting cells' electrodes and plates free of contamination.

Because of its greasy texture, airborne dirt collected on the electrodes and plates cannot be washed off with just hot or cold water, even when a conventional adhesive such as water soluble oil is applied after each cleaning. In addition, after a series of washings and adhesive applications, the electronic cells become coated with black build-up. The result is often service problems as well as lowered operating efficiency.

Dax, the new double-acting preparation developed by Electro-Air Cleaner Co., Inc., bypasses this problem by fusing the washing and adhesive application operation. When mixed with the wash water, Dax promotes cleansing of the collecting cells and dries, leaving an adhesive coating on collecting plates and electrodes.

The applicator system for Dax works with either vertical traveling washing systems or with horizontal fixed washing systems.

During the first two-thirds of the washing cycle, either hot or cold pure water is used to flush accumulated dirt from the collecting cells and to thoroughly wet the unit. At the beginning of the last third of the cycle, the metering pump starts and forces a two per cent Dax solution into the wash water.

Completing the Cycle

The soapy emulsion formed cuts the dirt from the metal surface, and the washing cycle is completed while the Dax solution is still being injected into the wash water. After the collecting cells have dried, a slightly tacky surface is left on the collecting plate and electrodes. This surface serves as an adhesive to hold collected dirt. It also facilitates the next washing.

Improving Adhesive Performance With

Aluminum Silicate Pigments

Long used in adhesives as extenders or fillers, aluminum silicate pigments are now being employed to improve actual adhesive performance as well as to make possible new and more demanding applications. These developments are largely the result of research by Minerals & Chemicals Corp. of America, Menlo Park, N.J., into surface modifications which make the pigments more hydrophilic or more organophilic.

Specific Advantages

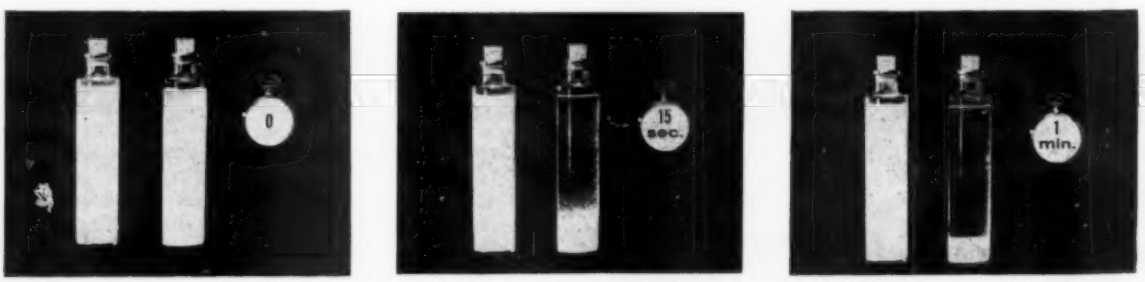
The specific advantage of aluminum silicate pigments (known as ASP's) in adhesives is that they provide excellent penetration control which keeps the adhesives at the glue line where their job is located. Other improvements to adhesives are faster tack and setting, adjustment of flow properties, and better suspension of adhesive ingredients. All these advantages are, of course, accompanied by lower over-all material costs which result from the substitution of ASP's for the more costly adhesive.

Research on aluminum silicate extender pigments has also led to benefits in the fields of paints, reinforced plastics, inks, and rubber. For example, in paints ASP's are used to increase flatness and hiding, and to give longer life. Their use in reinforced plastics reduces shrinkage and cracking and increases resistance to water and weathering.

Surface-modified ASP's are available in grades of three different average particle sizes: 0.55 micron, 0.8 micron, and 4.8 microns. The particle shapes are all thin flat plates or stacks of plates. All of the ASP's are specially processed from kaolin to remove hard particles, sand, mica, water soluble salts, and moisture. There are seven surface-treated ASP's available.

Among the hydrophilic variety, the oil absorption of ASP 101 is slightly higher than for ASP 100 untreated grade. ASP 102 and 602 are treated with a dispersing agent before drying. The result is formation of deflocculated suspensions of high fluidity in aqueous systems. Suspensions are therefore longer lasting and higher loadings of aluminum silicate can be made with less viscosity increase than is obtained with the untreated ASP 100 and 600.

Surface-treated ASP's 103, 105, 403 and 405 are organophilic and have applications in organic systems where their special coatings improve wetability (and dispersion).



Suspension test with equal amounts of surface-modified pigment (left-hand bottle) and precipitated $CaCO_3$ in mineral spirits. Pictures in this series were taken at the beginning of the test, after a 15 second interval and after an interval of one minute.

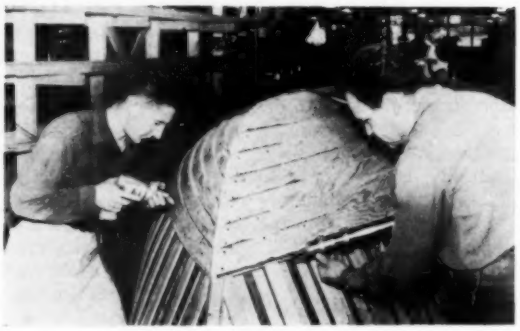
Boats *Can* Be Held Together With Adhesives

The small pleasure craft skimming across the water at top speed was held together only by adhesives. At the end of the test run careful examination showed that no leaks had developed and executives at Penn Yan Boats, Inc., Pen Yan, N.Y., knew that they had a foolproof answer to a problem that had been plaguing the industry for some time.

As boat fanciers well know pleasure craft of wood clinker type construction have a tendency to develop leaks in the planking joints. This is particularly true after the first season's use, and the problem has been traced back to the production methods generally used.

For example, the metal fasteners that hold the planking joints together are pulled into soaked and expanded wood. As a result, when the wood dries and contracts, the fasteners become loose and cause leaking. In addition, production men discovered that some rubber sealers used for pleasure crafts contain 50 per cent water and will shrink proportionately in drying so that an inefficient seal results. Caulking compounds have no bonding effect at all and will not adhere to the planking joints.

To meet this problem, Penn Yan now uses EC-1159, a high adhesion, water resistant sealer made by the Adhesives, Coating and Sealers Division, Minnesota Mining & Mfg. Co. The test run described above was used to illustrate the excellent adhesion achieved with this sealer. All plank-to-plank and plank-to-frame metal fastenings had been removed from the small craft and it was held together only by the 3M sealer.



Pressure gun is used to apply adhesive to planking lap joints of clinker type pleasure boat.

Under the new production setup, the sealer is applied to the planking lap joints by means of a pressure gun, and it vulcanizes to both sides of the seam. The hull, therefore, becomes practically an integral one-piece structure from keel to gunwhale and there is no chance of water leakage.

Double planking sealer EC-1159 is a chemically curing material designed for use between the inner and outer planking surfaces of lap joints and on other faying surfaces of wood boats. Upon the addition of an accelerator, this viscous paste cures to a tough rubbery state.

Because of its excellent flexibility and high tensile strength, the sealer stretches as seams widen. It is crack-proof and watertight, and the long service life seal requires little maintenance.

Outstanding resistance to water, outdoor weathering, gasoline, oil, and most commercial solvents are among EC-1159's outstanding features. It will withstand temperatures as low as minus 40°F. without becoming brittle and does not soften or deteriorate when exposed to temperatures up to 225°F.

Tapes Protect Metal Surfaces

A new self-adhering tape is now making it possible to protect the surfaces of formed metal products so that from the sheet metal stage to actual consumer installation there is no danger of scratching or weather staining.

Expected to be a boon to manufacturers, of easily-scratched stainless steel and chromed metal products, Protecto-Mask was developed by Mystik Adhesive Products Inc., Chicago, Ill. The paper-backed tape is rolled onto sheet metal before it is formed and merely stripped away when the product is put to use.

Paper-backed, self-adhering tape is rolled onto a sheet of stainless steel which will be formed into a restaurant counter.

The adhesive for this self-adhering tape was especially developed for this application by Naugatuck Chemical Division, United States Rubber Co. It forms a protective film on the metal surface and prevents scratches, rusting, oxidizing or staining even when the tape's paper back is ruptured in a bending or forming operation.

Supplied in rolls of 100 or 200 yards, and in widths ranging from one-half inch to 48 inches, Protecto-Mask can be applied to flat metal surfaces either manually or mechanically.

NEWS OF THE

ADHESIVES WORLD

Armstrong To Distribute Eastman 910 Adhesive

Eastman 910 Adhesive, a bonding material which is said to be solving a wide variety of difficult assembly problems, will now be available from the Industrial Division of the Armstrong Cork Co., Lancaster, Penna., as well as the Chemical Division of Eastman Chemical Products, Inc., subsidiary of Eastman Kodak Co., New York, N. Y. Introduced as a laboratory curiosity a year ago by Eastman Chemical, Eastman 910 Adhesive was the first bonding material developed that produced high strength bonds between virtually any combination of materials without excessive pressure, heat, solvent-evaporation or long curing time, according to the company.

Wide Use Cited

Dr. James E. Magoffin, vice-president of Eastman Chemical, stated at a recent press conference that the wide range of industries interested in the use of the adhesive required that marketing plans include an organization well versed in the field of adhesives and equipped to provide on-the-spot technical assistance and laboratory service. As one of the foremost manufacturers and distributors of adhesives, Armstrong Cork, through its Industrial Division, was selected as being particularly well qualified to aid in marketing Eastman 910 Adhesive and in handling service problems of users on a worldwide basis.

At the press conference, A. J. Slosser, manager of industrial sales for the Industrial Division of Armstrong Cork, said that Eastman 910 is an entirely new approach to adhesive bonding and very possibly a new "break-through" in industrial adhesive technology. He stated that a perfect adhesive would bond a wide variety of metallic or non-metallic materials; would be ready to use directly from the manufacturer's package; would develop high strength bonds without the use of heat or great pressure; would develop high strength bonds instantaneously; and would be colorless.

Tests conducted by Eastman and the Armstrong Research and Development Center, showed that Eastman 910 Adhesive scores very close to a perfect mark on most of these counts. The compound is a chemical which, under certain controllable conditions reacts within itself and causes the adherends which it "wets", to bond tenaciously together, he explained. The reaction and the resulting strong bond are relatively instantaneous. This characteristic, Mr. Slosser said, is unique and can mean great savings of time and labor.

The adhesive is expected to further overcome some of the barriers that mechanical fastening imposes on design or production line adaptability. A number of important uses are envisioned for the product—uses where adhesives have not heretofore been able to meet production requirements. It may also permit innovations in design which utilize combinations of dissimilar materials which cannot now be combined by means such as welds, solders, etc.

Highly important also, Mr. Slosser said, is the principle by which Eastman 910 appears to work. This principle is a new approach to adhesive bonding and Armstrong expects to explore its potential as a prototype from which possibly a whole series or group of new industrial adhesives may develop. The company feels that exploration of the frontiers of the development, applications and use of adhesives has just begun. Modern adhesives are described as new, increasingly useful assembly tools in industry. Improved adhesives, developed to meet new fastening needs, are expected to continue to offer fast, economical methods of production and to open new fields of design possibilities.

Significant Applications

Significant applications for the new material were described by members of Eastman's technical staff. These applications included the use of the new adhesive in solving production assembly problems for such products as trophies, fountain pens, high fidelity phonograph cartridges, radiation measuring instruments, strain gages, rubber swimming masks, tools, rubber imprinting plates, and automobile storage batteries.

In many of the applications discussed, the new adhesive was said to have made possible certain innovations in design which previously had been considered impractical, if not impossible, on a production line basis.

Pioneer Merges

Pioneer Engineering & Manufacturing Co., Inc., Detroit, Mich., announced its merger with Wettlaufer Engineering Corp., Detroit, Mich. With the acquisition of Wettlaufer assets, this organization is reported to be the largest engineering company of its kind in the country. Pioneer plans to reorganize Wettlaufer into an operating division similar to its Douglas Tool Co., Detroit, Mich. The new engineering organization will provide industry with a broader range of services than has previously been available. The various divisions will continue to serve industry in their respective capacities as in the past. In addition, however, product ideas now can be carried through all of the engineering phases of design and development down to the fabrications of actual jigs, fixtures and tools needed to make the product—all within a single integrated organization.

Majac Appoints Agency

Majac, Inc., Pittsburgh, Penna., a subsidiary of the Blackstone Corp., has appointed W. S. Walker Advertising, Inc., as its advertising and public relations agency. The company specializes in the design and manufacture of jet pulverizers and air classifiers for precise pulverization, classification and other processing of solid substances in the chemical, mineral, ceramics, plastics and other industries. The Majac jet pulverizer utilizes compressed air to attain high velocity impacts between product particles being ground. Steam, gases and refrigerated air may be utilized in the firm's equipment, which can also be used to coat solids with various chemicals for drying, blending, and exfoliation.

Named Supervisor

Marc Archambault has been named supervisor of technical service for the Montreal Division of National Adhesives (Canada) Ltd., a subsidiary of National Starch Products, Inc., New York, N.Y. Mr. Archambault will direct technical service on all of National Adhesives products, including base resins, packaging and structural adhesives and starches. He has been with National Adhesives since 1948, and since 1955 he supervised technical service in the Toronto Division. He has a B.S. degree from the University of Montreal.

Portrait Of

Bernard Gould

Mr. Gould, a member of the ADHESIVES AGE Editorial Advisory Board, has been in industrial marketing for 20 years and has had extensive experience in various phases of the "fastening" industries. Since 1953, he has been associated with Rubber and Asbestos Corp., Bloomfield, N. J., which currently celebrates its 45th year as a manufacturer of industrial adhesives exclusively. Previously, he served with Eutectic Welding Alloys Corp., Flushing, N. Y., where he participated in the first marketing program in the United States to introduce epoxy-based adhesives to the American metal-working industry.

Mr. Gould is a graduate of the School of Business Administration, New York City College, and teaches a graduate course in Industrial Advertising at the Evening Session of that school. He contributes to the industrial press in the field of industrial marketing, and has also written many articles on basic production problems in welding, brazing, soldering, and industrial adhesives usage.

Mr. Gould has appeared as a guest speaker on industrial marketing topics before the American Marketing Association, National Industrial Advertising Association and other groups, and has received close to a dozen national awards in the field of industrial marketing. He believes that adhesives usage in American industry as a mass production technique has been barely surface scratched.

Labeling Adhesive

A bottle labeling adhesive, called Chemite, has been introduced by National Starch Products, Inc., New York, N.Y. Chemite is reported to combine easy machinability, good gripping power, extended pot stability and lower unit production costs. A modified casein adhesive, it is also reported to be resistant to ice and water, suggesting its use by the food and pharmaceutical industries in labeling glass containers. Hot-melt adhesives in granular form have also been introduced by National. Because the granular hot-melt adhesives soften when heated and solidify when cooled, they are reported to be especially suited to bonding such impervious surfaces as aluminum foil and thermoplastic packaging films. Other advantages noted include ease of application, lower per-pound cost, adaptability to high production speeds and elimination of the need for pre-melt equipment.

Construction Meeting

Some of the world's foremost authorities are expected to meet at the Fourth National Construction Industry Conference, sponsored by the Armour Research Foundation of the Illinois Institute of Technology, to be held on December 10 and 11 at the Hotel Sherman in Chicago, Ill. The meeting will bring together authorities in esthetics, sociology, psychology, architecture, building, engineering, and city planning to discuss human needs in cities of the future. The opening session will stress human needs in urban society and the remaining three sessions will be devoted to responses from architects, engineers, and builders. Inquiries concerning the conference should be addressed to M. J. Jans, conference secretary, Armour Research Foundation, 10 West 35th St., Chicago 16, Ill.

Speeds Masonry Laying

Installation time and material are said to be cut in half with the new Vita Mortar Gun which can be used for masonry laying, caulking and pointing up jobs. Operating on 110-115V, AC or DC, the gun spreads mortar easily and quickly. Nozzle reducers are easily attached and detached. The complete unit is available from Vita Labor Saving Tools Co., Winter Park, Fla.

Top row (left to right): H. L. Dixon, L. R. Turner, N. L. Melbye and J. L. Been. Bottom row (left to right): B. F. Warmer, F. M. Jeffe and C. W. Walton.

Adhesives Council Elects Officers

Rubber & Plastic Adhesive & Sealant Manufacturers Council re-elected H. L. Dixon (B. F. Goodrich) as president of the organization at a meeting held on September 10-12 at the St. Clair Inn, St. Clair, Mich. as announced in the November, 1958, issue of this publication. Also re-elected were L. R. Turner (St. Clair Rubber) as first vice-president; N. L. Melbye (Angier Adhesives) as second vice-president and J. L. Been (Rubber & Asbestos) as third vice-president. B. F. Warmer (Coast Pro-Seal) was named treasurer. The officers, who will serve through September, 1959, were also elected to the organization's Steering Committee along with F. M. Jeffe (Pierce & Stevens) and C. W. Walton (Minnesota Mining).

News in Brief

Production is expected to start early in 1959 at **McKenzie River Plywood Corp.**, a new plant at Springfield, Ore. The organization is headed by Carl E. Anderson, former vice-president and general manager of the Springfield Plywood Corp.

A new product-development laboratory devoted to the diagnosis and development of packaging techniques has been opened by **Union Bag-Camp Corp.** in Hoboken, N. J.

Plans have been announced by the **Edwin J. Schoettle Co.**, Philadelphia, Penna., for the building of a folding-paper-box plant in Montgomery County, Penna.

An envelope with a built-in latch string for zip opening has been developed for **The Connelly Organization**, direct mail specialists. Turned out at the rate of 8000 per hour in a completely automatic process, the envelopes receive the zip-opener by an adhesive application rather than through stitching.

In line with its diversification program, **Philip Morris, Inc.** recently purchased Polymer Industries, Inc., Springdale, Conn., a producer of industrial adhesives.

Warehouse and display space of **Dealers Hobby Supply**, Dallas, Tex., has been increased by about 50 per cent as the result of a recent enlargement and remodelling program. The company also has branches in the South and Southwest.

Novoply, a three-ply board of pressed plywood chips and flakes that was developed by the **United States Plywood Corp.**, is being used by Rudnick Brothers, New York, N. Y., in the production of floor to ceiling folding doors. Floor and ceiling pivots and piano hinges are the only hardware used in this door unit.

A folding carton of polyethylene-coated board now in use at **Norwich Pharmacal**, Norwich, N. Y., is said to be the first ever to be successfully run on a boxmaker's standard glue-sealing machinery. A special treating of the coating permits high-speed gluing of polyethylene surfaces with common starch-type adhesives.

John F. Hogan, who previously served at the Pennsylvania Industrial Chemical Corp. and the Refined Products Co., has been appointed manager of the Market Development Department for Chemo Puro Manufacturing Corp.

Dr. Frank K. Schoenfeld, vice-president of research for the B. F. Goodrich Co., has been named to receive the Industrial Research Institute Medal for 1959.

T. S. Dewoody, Jr., who has been associated with the company since 1947, has been named to the newly created position of manager, technical staff, for the Electro Chemicals Division of the Diamond Alkali Co.

William T. Scott, group advertising and sales promotion manager of the Atlas Powder Co., and **Harry L. Darby,** vice-president of the Winner Manufacturing Co., have been appointed chairman and vice-chairman, respectively, for the Public Relations Committee of the Reinforced Plastics Division of the Society of the Plastics Industry, Inc.

Leo I. Dana has been appointed vice-president in charge of technology, and **David Swan** vice-president in charge of research for Linde Co., division of Union Carbide Corp.

Dr. F. H. Stross, Shell Development Co. research chemist, will join a new advisory group in the International Union of Pure and Applied Chemistry. He will be charged with recommendations for the presentation of data in the field of gas chromatography.

Walter H. Hindle, former director of applications research at Chemstrand Corp., recently joined Air Reduction Co., Inc., as consultant in connection with Airco's investigation of polyvinyl alcohol fiber.

Albert A. Nelson takes over as commercial research manager of Emery Industries, Inc., where he will conduct market studies, sales analysis, and profit pricing studies.

R. C. Vollmer has been named general superintendent of Trim, Engine Dress-up, Chassis and Final Assembly for the main Dodge assembly plant at Hamtramck, Mich., while **F. M. O'Connor** has been appointed general superintendent for Body Construction and Paint.

Brigadier General Monro MacCloskey, USAF (ret.), has been appointed assistant to the president of the Crosley Division of the Avco Manufacturing Corp.

Thomas L. Bonnitt, formerly associated with McGraw-Hill, Chas. Pfizer and National Dairy, has been appointed manager of the newly created Market Development Department for Morningstar-Paisley, Inc.

J. B. Ogden, vice-president, sales, at the Airtemp Division of the Chrysler Corp., has been re-elected chairman of the Room Air Conditioner Section for the National Electrical Manufacturers Association and **L. M. Larkin,** general manager of the Air Conditioning Division for the Whirlpool Corp., has been elected vice-chairman of the section.

Raymond W. Heimsoth, formerly vice-president and chief engineer of the Ess Instrument Co., has been elected president of the company, succeeding **Colonel C. C. Sheppard,** while **Eugene Ross** has been named vice-president in charge of sales. Mr. Ross has had a wide range of sales and merchandising experience.

Edward J. Keller, who serves in the Maintenance Department of Fritzsche Brothers, Inc., has been inducted into the firm's Quarter-of-a-Century Club.

Roy D. Perdue, formerly associated with the Springfield Armory where he had been doing chemical engineering research for the Ordnance Corps, has been appointed director of engineering for National Polychemicals, Inc., and **William M. Meeker,** previously sales engineer for the Pequanoc Rubber Co., has been named sales representative.

Maintenance Conference

A broad revision of session topics has been planned for the Tenth Plant Maintenance and Engineering Conference, to be held at the Public Auditorium in Cleveland, Ohio. The conference will run for three days, from January 26 to 28, while the Plant Maintenance and Engineering Show, also to be held at the Public Auditorium, will run for four days, January 26 to 29. At the show, approximately 400 companies are expected to demonstrate equipment, services and other products designed to keep plants and machinery in operation at the lowest possible cost.

Almost one-third of the topics to be discussed at the conference will be new to the program, for which 60 sessions have been planned. The opening session will be devoted to a study of the maintenance system of a nationally-important manufacturing company. Ten of the sessions will be round-tables devoted to special problems of individual industries.

Round-tables, discussing the nuclear industry, assembly plants, and the abrasive products industry are on the program for the first time. Other industries which will get special attention are metal working and metal fabricating, chemical, electrical manufacturing, petroleum processing, pulp and paper, foundries and research and development laboratories. Advance registration cards, conference and hotel information may be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N.Y.

English Plant On Stream

The Dunlop Factory at Castle Bromwich, England, opened officially in 1957, is now in full production and turning out adhesives at the rate of two million gallons a year. The factory consists of three processing plants: the main adhesive plant, which produces adhesives of the solution type and includes a plant for the manufacture of reclaim dispersions; a plant for the manufacture of latex compounds; and the Polimul plant for polyvinyl acetate, polyethyl acrylate, polymethyl acrylate and similar types of synthetic resin emulsions. The solvent based adhesives are formulated from natural, synthetic and reclaim rubbers and natural and synthetic resins. The main industries served include the motor and coach building; the building and flooring; the footwear; textile, shipbuilding, aircraft and packaging.

Airco Completes Murray Hill Unit

Air Reduction Co., Inc., New York, N. Y., has announced completion of an extensive addition to its Research and Development Laboratories at Murray Hill, N. J. The new addition, a two-story polymer laboratory costing over a half-million dollars to construct, was built to house additional chemical research facilities for the company's various operating divisions. In the new laboratory, particular emphasis will be placed on the development of polymers primarily for adhesives, paints, plastics, coatings, films, paper and textile treating agents.

The original building at Murray Hill, in which Air Reduction is engaged in a diversified research program in the field of chemistry, metallurgy and cryogenics for the development of new products and processes, was completed in 1947. Laboratory personnel today number 318, of which 68 per cent are said to be professional and technical employees.

Wide Range of Activities

Chemical research and engineering activities at these laboratories cover a wide range of work involving research for new chemicals, process development, product utilization studies, chemical engineering development and pilot plant work. The laboratories are presently engaged in chemical research and development in fine organic chemicals, primary intermediates for plastics and resins, plastics research (polymers), applications research and analytical services.

Metallurgical research activities at the laboratories include many phases of arc welding research, development of metallurgical treating agents for use in the iron and steel industry, product development in the inorganic field and development of customer-use processes. Other work includes process engineering and pilot plant activity and works-scale testing of products and processes in customer plants.

Murray Hill's cryogenic research activities include development and testing of equipment for handling liquefied gases, development of processes for the more efficient separation of gases by liquefaction techniques, and experiments to secure design data for low-temperature equipment and processes.

English Firm Opens Polymerization Plant

A new plant for the polymerization of a wide range of polyvinyl acetate emulsions is now on stream at Slough, Bucks, England. The plant is operated by National Adhesives Ltd., a subsidiary of National Starch Products, Inc., New York, N.Y. The new plant will provide a center for research and technical service facilities for emulsion technology in Great Britain. At the same time it will encourage the free exchange of new developments in these fields between National's British technologists and the company's research and development personnel in the U. S. The new installation now makes available a complete line of polyvinyl acetate emulsions for the paint, textile, paper and cement industries for shipment in bulk quantities to all areas of the British Isles, South Africa, Australia, New Zealand and the Continent. These products duplicate those which are currently being marketed by National throughout the United States and Canada. In addition, the Slough installation will also supply formulated resin emulsion adhesives for packaging application.

Canadian Unit Planned

National Adhesives (Canada) Ltd., a subsidiary of National Starch Products, Inc., New York, N. Y., has begun construction of a vinyl emulsion plant on the company's premises at 371 Wallace Avenue, Toronto, Ont., Canada. Initially, facilities of the new plant will have 5,000,000 pounds vinyl emulsion capacity annually, and will permit expansion to 8,000,000 pounds. The plant is expected to be on stream by March 1, 1959. It has been engineered to produce a variety of vinyl acetate polymers and copolymers to meet the specific requirements of the adhesives, paint, paper, packaging materials and textile producers.

Tate Appointed

Al Tate has been appointed supervisor of technical market development for the Toronto Division of National Adhesives (Canada) Ltd., a subsidiary of National Starch Products, Inc., New York, N.Y. Mr. Tate will be responsible for both sales and technical development on base resins and specialty starches. Mr. Tate joined National Adhesives in 1955 with extensive technical experience in paints. He holds B.A. and M.A. degrees.

Clad-On Wallcovering

Vinyl wall covering with an adhesive coated back is available from Masland Duraleather Co., Philadelphia, Penna., for use in offices, homes and institutions. The clad-on semi-rigid plastic sheeting comes in rolls 49 inches wide. A total of 37 colors is currently being offered by the company.

Nopco Elects Executive

Robert F. McClellan has been elected vice-president at Nopco Chemical Co., New York, N.Y. He was also appointed general sales manager of the Industrial Division. Mr. McClellan was previously vice-president of Nopco Chemical Canada Ltd., Canadian affiliate of the parent concern.

Catalin Is Licensed

Under a 10-year license agreement with Union Chimique Belge, Belgium, Catalin Corp. of America, New York, N.Y., will make and sell emulsions and solutions of acrylic polymers used for adhesives, plastics, paints and coatings as well as in many other products.

COMING SOON

The editors of ADHESIVES AGE have selected a great variety of articles for publication in future issues in order to provide the widest possible coverage of the vast adhesives industry. Watch for these articles scheduled to appear shortly.

- Selecting the proper sealant for curtain wall constructions
- How to dry mix basic resin adhesives
- Uses of epoxies and silicones in adhesives
- Rheology and electrokinetics of adhesives
- Resilient floor surfacing materials installed with adhesives
- Production problems minimized for adhesive container labeling
- Defoaming agents for the automatic application of animal glue
- Urethane foam bonded to stainless steel
- Industrial applications of rubber based adhesives
- Resin adhesives for palletizing operations
- Bindery adhesives find wide use at United Nations
- Adhesives for the food processing industry
- Animal glues find use in uranium reclamation
- Resin adhesive development and mixing

These and many other interesting articles will soon be in print

ADHESIVES AGE

101 West 31st Street, New York 1, N.Y.

ASTM D-14 Introduces Adhesive Test Methods

The American Society for Testing Materials recently adopted as standard, two adhesive testing methods previously designated as tentative. The new standards are: D 1205-53 T, Methods of Testing Adhesives for Brake Lining and Other Friction Materials; and D 429-56 T, Test for Adhesion of Vulcanized Rubber to Metal.

Two basic classifications come under the scope of the first of these test standards. In category A are methods for evaluating the strength and permanence of bonds. These tests are for materials used for bonding metal to metal, and for bonding brake lining to metal. They include tension tests at room and elevated temperatures.

Test plugs are fixed to the movable member of a tension testing machine and record is made of the rate of loading used, as well as the load at which the bond fails. Using static load test apparatus, records are also made of the highest temperature at which a specimen under static load fails, and of the length of time for failure of a specimen under static load and under constant temperature.

Under category A of this standard also come shear tests for brake and shoe lining assemblies at room, elevated and cycling temperatures. The shear test apparatus used in the latter investigations is also employed in a series of tests designed to investigate the resistance of brake shoe adhesives and tapes to fluids encountered in service. Specimens are immersed in test liquids for seven days at a temperature of 23± 1.1°C. They are then placed in a suitable shear fixture and loaded to destruction at a prescribed loading rate. Record is made of the loss in shear strength and the type of failure.

Test Category B

Methods for measuring the shelf life of bonding cements, tapes and adhesive film on coated brake linings are outlined in test category B of this standard. The dried cement film or tape is aged for a predetermined time at either room or elevated temperatures and then subjected to the same procedures used in shear testing.

In addition, flow tests of aged bonding tape and cement films are made by placing circular samples of known diameter and thickness between sheets of uncoated heat-stable cellophane, 0.001 inch thick, and measuring the specimen thickness. The specimen is next placed between two metal plates and oven cured for 30 min. at 400°F. under 100 psi pressure. Computation is then made of the percentage decrease in original thickness.

Production has started in this new $2,500,000 plant for the manufacture of B. F. Goodrich adhesives, which is located in Akron, Ohio. The streamlined two-story plant contains 70,000 square feet of floor space and houses a development laboratory and modern production facilities. Approximately 100 persons are employed.

Rubber-to-Metal Tests

The ASTM standard for testing the adhesion of vulcanized rubber to metal also outlines two test methods. The first is designed to test a rubber part mounted between two parallel metal plates. The vulcanized standard test specimen is mounted in a tension testing machine and a steady tension load applied at a specified machine speed until the rubber either separates from the metal surface or ruptures. The total load at the time of failure is recorded and calculation made for the expression of adhesion value in pounds per sq. in. Of course, in the case of rubber rupture, adhesion bond cannot be measured, but is known to be greater than the rubber strength itself.

The second test method outlined in the standard is intended for determining the adhesive strength of elastomer-to-metal bonding agents. The results are obtained by measuring the pull necessary to separate a rubber strip from a metal surface. Final data indicates the strength of adhesion along a line across the width of a rubber strip being separated from a metal plate at a 90° angle.

The procedure in this method is to place the test specimen in the jaws attached to a quadrant with the separating edge toward the operator. Before the load is applied, a sharp knife is used to strip 1/16 in. of the rubber from the metal plate. The tab is placed in the grip and a steady load is applied at the rate of two inches per min. until separation is complete. Adhesion values over the full length of the test specimen are obtained by using an autographic recorder.

Ice-Proof Paste

Leicester, Lovell & Co., Ltd., England, have developed an ice-proof labeling paste which is designed to keep the label on the bottle when it is put on ice. The product, called Casco Label Paste 963, is reported to provide immediate adhesion allowing bottles to be sheathed without delay. It is also claimed that the efficiency of this new paste is such that either wet or dry bottles may be labeled while the sweating problem is eliminated.

Melurac Resins

Two adhesive resins have been made available by American Cyanamid Co., Bound Brook, N.J. They are Melurac 260 and Melurac 305. Melurac 260 is a melamine-fortified urea resin with catalyst incorporated. It is a tapeless splicer glue designed to provide fast curing in veneer bonding operations. Melurac 305 is a general purpose adhesive resin. A filled melamine-urea adhesive in dry powder form, it gives improved assembly time flexibility and will give good bonds with hard-to-glue woods.

Russia To Increase Chemical Production

A recent article in *Chemical News*, issued by the Manufacturing Chemists' Association, states that the Soviet Union plans a new seven year program in which an expenditure of $25 billion on the USSR chemical industry, is called for. Emphasis is placed on expansion of the Soviet plastics, synthetic fibers and synthetic rubber industries. Speaking before the May plenary session of the Central Committee of the Communist Party, Khrushchev justified the expansion as "the most important factor in further technical progress and in the rapid growth of the productivity of communal labor in all branches of the national economy."

The new drive calls for a 700 per cent increase in plastics and synthetic resins production, a 360 per cent increase in synthetic fibers, plus a 270 per cent increase in synthetic rubber production. The most recent five year plan, slated for completion by 1960, was scrapped since it became obvious its goals could not be met, *Chemical News* said.

Consumer Goods

The MCA believes that Khrushchev is working on the presumption that increased output of plastics and other synthetics will make clothing, home construction and other consumer items cheaper and will also free additional large quantities of raw materials for consumer goods production. Declining productivity is said to be a real problem in Russia. During the period of 1950 through 1955, Russian productivity rose at the rate of almost six per cent a year. Today, informed sources place its rise at a little more than three per cent per year.

Fulfillment of the plan, according to Khrushchev, depends on plans "to build or reconstruct from 1958 to 1965, a total of 257 enterprises of chemical and related enterprises." These include the completion of 37 enterprises already under construction; building and putting into operation 120 new ones, and expansion of 100 enterprises, already functioning. It was admitted that the USSR seriously lags behind "some capitalist countries" in producing synthetic fibers, other synthetic materials and plastics. He stated that world-wide, the Soviet Union ranks sixth in synthetic fiber production and fifth in plastics production.

Success of the Plan

Success of the seven-year plan hinges in large measure on the rapid assimilation of technical know-how and processing equipment, *Chemical News* states. The fastest way would be outright purchase. Purchase of processing equipment and technical know-how from other Socialist countries was advocated and the possibility of purchasing from the United States, West Germany and Britain was also admitted by Khruschev.

The USSR now lags behind the United States as a plastics producer, MCA says, but may catch up and take the lead by 1965. The United States leads Russia in the production of all types of polymers by a wide margin. Their research in this area is about 30 to 40 per cent of this country's polymer research and development. However, an American polymer authority, recently returned from a tour of the USSR, reported that their research is of good quality. Actual plastics production in the USSR is estimated at about 88 per cent less than it is in the United States.

1957 Output Figures

Figures for 1957 output recently released by the Soviet Union's Chemical Ministry were: phenolic and other tar-acid resins, 143.3 million pounds; epoxy resins and alkyd resins, 64.4 million pounds; urea and melamine resins, 118.6 million pounds; thermoplastics, 133.4 million pounds. Total for all USSR plastics production was 536.8 million pounds.

United States output for these particular resins are: phenolic and other tar-acid resins, 532.3 million pounds; epoxy and alkyd resins 395.7 million pounds; urea and melamine resins, 349.1 million pounds; silicones, 3.4 million pounds, and thermoplastics 2.4 billion pounds. These together with other types of resins, total 4.5 billion pounds.

On a projected per capita basis, should the United States reach the expected 1965 production rate of 7.3 billion pounds and the population reach 195 million, plastics output per capita will be 37 pounds. If Soviet 1965 goals are fulfilled, plastics output will measure about nine billion pounds. Allowing for a population increase to 230 million by that year, per capita output will be 39 pounds.

MCA states that Russia would be willing to spend at least $100 million immediately for the purchase of processes and services from the United States, ostensibly for "development of consumer goods output."

In its editorial, *Chemical News* warns against this. It states that once Russia has them, it can use chemical processes and know-how as it wishes, for consumer production—or war. Russia's foreign trade can be strengthened as a political economic weapon because cut-rate prices are no problem for the Soviet's state-run monopolies. MCA also believes that the superiority of our chemical industry is one of our great advantages over Russia and should not be bartered away lightly.

Epoxy Resin Plant

Australia's first epoxy resin plant will be built at Clyde, Sydney, by the Shell Oil Co. The plant is expected to be completed in 1960 and will cost over $1.3 million. Both liquid and solid grades of Epikote resins will be produced at the installation. Designed to meet Australia's present requirements, allowance has been made for future expansion.

Reports Profits Down

British Glues & Chemicals Ltd. in their annual report for the year ended March 31, 1958, stated that profit margins, owing to generally increased costs, were somewhat reduced in a period of more difficult trading conditions. Consolidated profit for the year is £743,094 as compared with last year's consolidated profit of £740,547.

Fox Glue Guns

John P. Fox Co., Monrovia, Calif., has introduced a new line of spot-glue guns especially designed for the accurate positioning of ¼ to 1-inch circular spots of glue on carton flaps. The guns are available in automatic and manual models.

Minnesota Sales High

Minnesota Mining and Manufacturing Co., Minneapolis, Minn., has announced that the period which ended September 30 represented the second largest quarterly sales volume in the company's history, exceeded only by the fourth quarter of 1957. The company reported common stock earnings of $11,921,415, which is equal to 71¢ per common share for the three months which ended September 30, compared with $9,722,505 or 58¢ per share, in the same quarter last year. Sales in the third quarter of 1958, the company said, were $95,104,809, compared with $92,646,950 last year. Minnesota's peak sales volume, reached in the last quarter of 1957, was $95.9 million.

Improved results for the third quarter brought the firm's first nine-month earnings to $29,568,080, or $1.75 per share, against $29,415,485, also $1.75 a share, at the same time a year ago. Sales for the first nine months of this year were slightly below those of last year, totaling $271,366,401, compared with $274,225,317, in the same period last year. The company said that while increased third quarter sales were primarily responsible for the company's improved profit picture, continued progress in improving many phases of operations was also an important factor.

Self-Adhering Shingle

The new roofing shingle announced by Philip Carey Mfg. Co., Cincinnati, Ohio, features an adhesive coated back of pressure sensitive Sta-Seal. The wide adhesive band is covered with a protective tape which when removed allows the tacky consistency of the adhesive to engage the next course of shingles. There is no dependency on the heat of the sun for sealing. Available in 11 colors, the Chex 325 roofing shingle has only two 18 inch tabs instead of the customary three.

Vinyl Tile Adhesive

A new brush-on emulsion type of adhesive announced by Kentile, Inc., is said to facilitate the installation of vinyl asbestos tile. Water and alkali resistant, the adhesive assures strong initial tack and permanent bond. The manufacturer points out that one gallon will provide coverage for about 250 square feet.

Plastics Conference

The 14th Reinforced Plastics Conference will be held on February 3, 4 and 5, 1959, at the Edgewater Beach Hotel, Chicago, Ill. Subjects to be covered during the conference include: Joining of Reinforced Plastics, Preform and Mat Die Molding, High Temperature Application, Mechanical Behavior of Reinforced Plastics, Tooling, Aircraft and Missiles, Premix, Commercial and Military Transportation, Reinforced Plastics Research, Raw Materials, Commercial and Naval Boats, and Reinforced Plastics Panels and Building Use. The subject of Joining will cover adhesive bonding and mechanical fastenings, types of bonds involved in adhesion and effects of stress concentrations on the strength of reinforced laminates.

Larson Formica Distributor

Larson Distributing Co., Denver, Colo., has been appointed the Colorado distributor for Formica Corp., subsidiary of American Cyanamid Co. Larson will handle distribution of all Formica decorative surfacing materials and adhesives. The R.P.M. Corp., Denver, Colo., former Formica distributor in this region, will concentrate on specialty fabricating with decorative plastic laminates.

Concrete Bonding Agent

A free flowing liquid bonding agent announced by Larsen Products Corp., Bethesda, Md., will permanently bond new concrete or topping directly to old concrete. Weld-Crete can also be used with brick, wood, tempered hardboard, gypsum board, concrete block, metal, ceramic tile, glass and other surfaces.

"Quick—develop a new glue for this fancy bottle we just ordered!"

Aqueous Adhesive System

An aqueous adhesive system for bonding elastomers to cord or fabric of synthetic fibers is described in Report BL-338 by C. H. Gelbert and G. E. Owen, issued by the Elastomer Chemicals Department, E. I. du Pont de Nemours and Co., Wilmington, Del. The adhesive system is based on Hylene MP and neoprene latex Type 635. Hylene MP is a diisocyanate which has been reacted with phenol to block or inactivate the isocyanate groups and is not reactive towards water. A recipe is given for a compound which gives excellent adhesion of neoprene or styrene-butadiene rubber to nylon and to Dacron fiber fabric. The preparation of dispersions of Hylene MP, zinc oxide and an antioxidant (Zalba) for use in the adhesive compound is described. The fabric is treated with the adhesive compound; the unvulcanized elastomer is applied and then vulcanization is carried out under moderate pressure to effect bonding between the elastomer and the fabric.

Borden Earnings Up

Borden Co., New York, N. Y., has announced that third quarter earnings in 1958 were up over the comparable 1957 period although dollar sales were down slightly. Third quarter sales in 1958 were $231,376,016, down 3.9 per cent from the $240,773,974 in the 1957 third quarter. Earnings were $6,949,844, up about 6.5 per cent from the 1957 $6,528,181 figure. Third quarter earnings per share were $1.43 on 4,863,402 shares outstanding on September 30, compared with $1.34 for the 1957 third quarter after adjustments for a 4 per cent stock dividend on January 3, 1958. Sales in the first nine months of 1958 were $680,964,070, down 2 per cent from the comparable $694,882,200 figure in 1957. Nine month earnings were $18,212,882, up 1.6 per cent from the $17,930,301 figure in 1957. Earnings per share were $3.74 against the adjusted figure of $3.68 in the nine month period of 1957.

Vinyl-Fabric Bondant

An adhesive for bonding vinyl compounds to fabrics of nylon and Dacron polyester fiber has been developed by E. I. du Pont de Nemours, Wilmington, Del. The adhesive, called NVD, is reported to have a high bond strength and good shelf life.

ADHESIVES ⇨ ⇨ NEW MARKET

FURNITURE: Here a Drexel Furniture Company supervisor checks a built-up laminated core for diningroom furniture using P-631 Plyamine. Gluing is an important factor in Drexel's operation, which runs as high as 120 surface feet every eight minutes, ten hours a day. (Reichhold Chemicals, Inc.)

RADIOS: A printed circuit made up of electrolytically deposited copper on an epoxy-based adhesive—placed on an epoxy-impregnated fiber glass baseboard.
(Rubber and Asbestos Corporation)

PLYWOOD: The first assembly process in the production of 5- or 7-ply fir plywood panels. Sheets of veneer are fed through rollers bathed in a continuous flow of adhesive.
(United States Plywood Corporation)

Adhesives bond together a great new market

A common bond among companies large and small, in every variety of industry, is adhesives. They're bought and used in the making of plywood, radios, furniture . . . aircraft, jewelry, household appliances . . . luggage, books and boats.

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Mills Shepard research is working now to define clearly the enormous scope of this new market—a market that will be "packaged" for the first time by a publication that concentrates its entire circulation wherever adhesives are made and used. Among manufacturers of all kinds and types of adhesives. Among companies who use adhesives in their own production and packaging. Among companies who buy and re-sell adhesives in conjunction with their products . . . and among suppliers of all goods, services, machinery and equipment for the production and shipment of adhesives.

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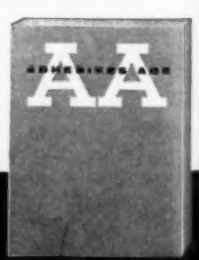


ADHESIVES AGE NEW MAGAZINE

Packaging Adhesive

Rubbatex, a packaging adhesive especially designed to bond seams and bottom flaps of polyethylene-lined kraft or burlap bags and other containers, has been developed by Rubba, Inc., New York, N.Y. Rubbatex is reported to form a strong, permanent bond with polyethylene that is impervious to extreme changes in temperature. It is claimed to be a shock-resistant, flexible, non-crystallizing adhesive. Because of its fast-grabbing ability, it appears to be suited for high speed production. The adhesive is available in several viscosities, depending upon the manufacturer's specific requirements.

Laminol Adhesive

A vinyl-to-metal laminate, called Laminol, is being marketed by American Nickeloid Co., Peru, Ill. It is a permanent fusion of solid vinyl film to chemically treated steel or aluminum. The material is reported to be highly resistant to abrasion, impact and staining, with color and surface embossing remaining stable. Laminol is available in sheets to 32 by 144 inches; coils up to 32 inches wide and all popular gauges and tempers.

Hercules Powder Co., Wilmington, Del., has awarded approximately $100,000 to 24 American universities in the form of unrestricted grants-in-aid.

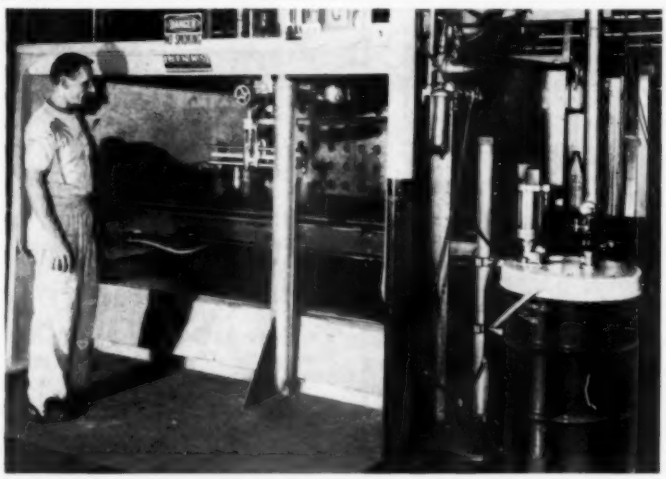
Adhesive Strapping Tape

A new self-adhesive strapping tape is being marketed by the Industrial Sellotape Division of Gordon and Gotch Ltd., 8-10 Paul Street, London, England. The tape is reported to have a minimum tensile strength of 180 pounds per inch width and needs no tensile machine or special equipment. Each inch width of the tape has 90-denier rayon threads laminated to vinyl film. It is said to be ideal as a bundling medium for banding heavy items and for holding spares to main units in transit. The self-adhesive tape is water-proof and will take printing.

Bonnitt Named Manager

Thomas L. Bonnitt has been named by Morningstar-Paisley, Inc., New York, N.Y., as manager of its newly created Market Development Department. Mr. Bonnitt formerly was with Chas. Pfizer & Co., Brooklyn, N.Y., and National Dairy Products Corp., New York, N.Y. The new department will provide evaluation and development of starch, gum, dextrin, plastisol, latex and adhesives products.

Slomons Laboratories, Inc., Long Island City, N. Y., is marketing a "Big Three Miracle Adhesives Kit" designed to solve all the gluing problems which confront the average homeowner.



The Binks automatic reciprocating spray machine booth, shown here, is used at the Panelfab Products Co., Miami, Fla., to spray adhesives in its bonding operations. Laminating adhesives are automatically spray applied to panel materials by this system, which consists of an automatic reciprocating spraying machine in a conveyorized spray booth; a material handling pump and pump elevator, and an oil and water extractor and accessories.

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Dec. 8-9. 42nd Annual Meeting of Toy Manufacturers of U. S. A., Inc., Waldorf-Astoria, New York, N. Y.

Dec. 10-11. Fourth National Construction Industry Conference, Hotel Sherman, Chicago, Ill.

Jan. 5-6, 1959. Winter Market, American Furniture Mart, Chicago, Ill.

Jan. 5-16, 1959. International Home Furnishings Market, Merchandise Mart, Chicago, Ill.

Jan. 12-16, 1959. National Housewares Exhibit, Chicago, Ill.

Jan. 31-Feb. 4, 1959. Hobby Industry Association Trade Show and Convention, Hotel Sherman, Chicago, Ill.

Feb. 2-5, 1959. National Auto Accessories Exposition, New York City Coliseum, New York, N. Y.

Feb. 3-5, 1959. 14th Reinforced Plastics Conference, Edgewater Beach Hotel, Chicago, Ill.

Feb. 23-26, 1959. 44th TAPPI Annual Meeting, Commodore Hotel, New York, N. Y.

Mar. 9-14, 1959. American Toy Fair, New Yorker and Sheraton-McAlpin Hotels, New York, N. Y.

Mar. 17-19, 1959. 15th Annual Conference and Corrosion Show, National Association of Corrosion Engineers, Sherman Hotel, Chicago, Ill.

April 5-10, 1959. American Chemical Society, Biltmore Hotel, Boston, Mass.

May 17-21, 1959. 61st Annual Meeting of the American Ceramic Society, Palmer House, Chicago, Ill.

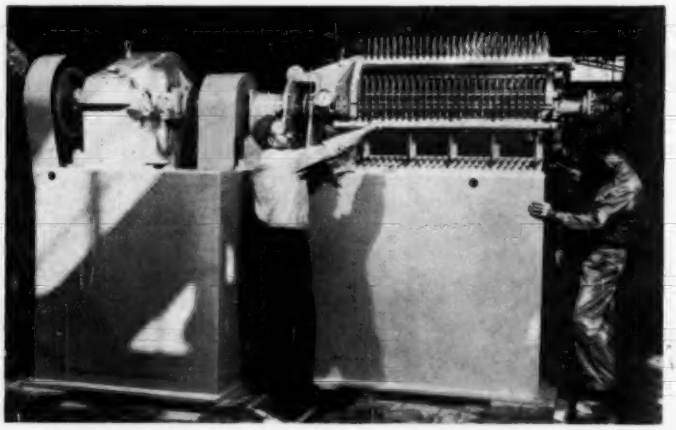
May 25-27, 1959. 10th TAPPI Coating Conference, Statler Hotel, Boston, Mass.

June 9-12, 1959. Materials Handling Institute Exposition, Public Auditorium, Cleveland, Ohio.

June 21-26, 1959. American Society for Testing Materials, Chalfonte-Haddon Hall, Atlantic City, N. J.

July 1-19, 1959. Chicago International Fair Exposition, Navy Pier, Chicago.

Aug. 18-21, 1959. 10th TAPPI Testing Conference, Multnomah Hotel, Portland, Ore.



This huge 50-horsepower, 18-inch diameter, 26-plate Flowmaster reactor being prepared for shipment by the Chemical Machinery Division, Baker Perkins, Saginaw, Mich., is reported to be the largest of its type built to date. It is capable of processing 3,000 to 6,000 pounds of resin and solvents per hour. Baker Perkins recently shipped two of the units with auxiliaries and spare parts to Yokohama. One is to be used for mixing and heating, the second unit (above) for mixing and cooling-ahead of a synthetic fiber spinning operation.

General Mills Plans New Research Center

General Mills, Minneapolis, Minn., will break ground in the spring of 1959 for their multi-million dollar research center, which will be built in Golden Valley, west of Minneapolis. The new center will provide facilities for exploring avenues of wide diversification and will turn intensified effort toward developing new high-nutrition, high-convenience food products.

The research center will be built in five steps, with an over-all final completion date extending to 1964-65. Floor areas will total about 360,000 square feet. The new building will have a long main section and several wings. A portion of the structure will be three stories above ground; other portions will be two stories, or one.

Step number one of the building program calls for the main stem of the building to be completed and ready for occupancy by June, 1960. The various wings will be constructed in later steps and occupied as soon as completed. The center will be staffed with 500 scientists and associated workers.

Appoints Mechelec

Isochem Resins Corp., Providence, R.I., has appointed Mechelec Sales Co., Medford, N.J., as its sales representative in the Mid-Atlantic territory which includes the southern half of New Jersey, Delaware, Maryland, the District of Columbia, and the eastern half of Pennsylvania. Mechelec will handle the full Isochem line of epoxy and polyester coating, potting and casting resins and epoxy adhesives, as well as the companion line of Isotrip and Isoterge clean-up and stripping agents for resin users. Edward Penberthy will be chief sales engineer for the territory.

Adhesive Surfaced Foam

A packaging and display material which consists of polyurethane foam coated on both sides with a pressure-sensitive adhesive is being marketed by Panostic Display Co., Ltd., London, England. The material, available in one and two inch wide strips, 50 yards long, can be used for packaging fragile articles or products which must be fixed to their containers. The adhesive surfaces are protected until needed for use by a vinyl film which can be peeled off.

Designers Re-Elect Officers

At the Annual Meeting of the Board of Trustees, October 9-10, in New York City, the Industrial Designers Institute re-elected the following officers: Robert E. Redmann (University of Bridgeport), president; H. Creston Doner (Libbey-Owens-Ford), national secretary; Leon Gordon Miller (Consultant), national treasurer; George A. Beck (General Electric), chairman of the board. Carl Bjorncrantz (Sears Roebuck) was re-elected executive vice-president but resigned in order to devote his time to the Eighth Annual IDI Design Awards program, of which he is chairman. John S. Griswold (Griswold, Heckel & Keiser) was unanimously elected to fill the post.

The National Conference of the Industrial Designers Institute, held on October 8-10 at the Sheraton-East Hotel, New York City, included a series of talks, discussions and panels centered on the theme "What's New?" The Design Materials Show, held in conjunction with the meeting, presented the latest in materials, services and processes of interest to industrial designers.

Pease Appointment

Harrison Pease has been appointed assistant to Walter S. MacPhail, vice-president and merchandise manager of Wamsutta-Pacific Industrial Fabrics, a division of M. Lowenstein & Sons, Inc., New York, N.Y. Mr. Pease will concentrate on expanded sales development, product and market research in industrial fabrics of all types used in specialized industries. He was formerly with Exeter Manufacturing Co., Dan River Mills and Spring Mills, Inc., wth extensive experience in the industrial fabric field.

New Bonding System

A rubber-to-metal bonding system, called permadizing, has been developed by Stillman Rubber Co., Culver City, Calif. Rubber-to-metal bonded parts are said to be free of flash, precise in dimension and have optically flat surfaces for effective sealing at almost zero pressure. The new bonding process can be used with almost any metal and provides a rubber-metal composite whose dimensions can be held as closely as all-metal parts. Rubber surfaces as fine as five-micron-finish are produced.

Silicone rubber tape evaluation kit introduced by Permacel

Silicone Tape Evaluation Kit Introduced

Permacel, New Brunswick, N. J., has introduced a Silicone Rubber Evaluation Kit to acquaint engineers with the firm's line of silicone rubber tapes. Said to be the first evaluation kit of its kind on the market, it is expected to reduce the time consuming and costly sampling procedures required to arrive at the most desirable tape construction for a particular application. The kit, which is packed in a sturdy display box, consists of sample rolls of six Permacel silicone rubber tapes, a representative sample of three standard products and three new silicone rubber tapes.

In addition, a general information pamphlet is included which describes the advantages and technical details of silicone rubber tapes. An index and swatch card list all Permacel silicone rubber tapes with specifications for easy reference, as well as product use, and data sheets list construction, properties, shelf life, characteristics and uses of all Permacel silicone rubber tapes.

Reichhold Foreign Plants

Reichhold Chemicals, Inc., New York, N. Y., has reported the increased capitalization of three chemical companies in Europe. Capitalization of Reichhold's Swiss company, Oel & Chemie Werk A. G., will be doubled from 2½ to 5 million Swiss francs, making possible the construction to a new plant which will produce 3,000 tons of phthalic anhydride per year. Reichhold Chemie A.G. in Germany, will double its phthalic capacity following an increase in capitalization from 4 to 5 million marks. Capitalization of Reichhold-Beckacite S.A., will rise from 400 to 600 million francs as capacity for production of various chemicals is increased.

Tile Adhesives

Leicester, Lovell and Co., Ltd., North Baddesley, Southampton, England, are now marketing two tile adhesives developed by Borden Chemical Co., their associates in the U.S. The adhesives are being sold in the United Kingdom under the trade names Cascoset M-1193 and Cascoset M-1185. It is claimed that Cascoset M-1185 will give complete waterproof bonds making it ideal for those tiles which have to be laid below damp, course surfaces. Cascoset M-1193 combines strength with flexibility and has been developed for bonding high vinyl tiles and those surfaces where satisfactory adhesion has been previously found difficult to obtain.

patent review

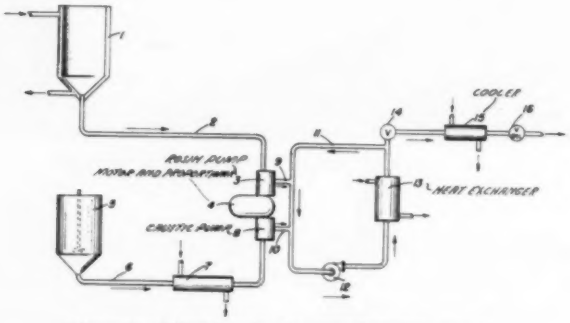
By MELVIN NORD

Liquid Rosin Size

U.S. Patent 2,842,453, issued July 8, 1958 to Joseph M. Anderson and Floyd B. Porter, Jr., assigned to American Cyanamid Co., describes a continuous process for manufacturing liquid rosin size, in which molten rosin or similar acid is continuously dispersed in hot aqueous alkali containing a recirculated alkali metal salt of the rosin acid as dispersing agent. Liquid rosin size is formed from the thus dispersed rosin.

As shown in the schematic diagram, a steam-jacketed rosin kettle (1) delivers molten rosin through a rosin supply pipe (2) to one side (3) of a proportioning pump (4), and an aqueous alkali supply tank (5) delivers alkali solution through supply pipe 6 provided with a heat exchanger (7) to the other side (8) of the proportioning pump. The molten rosin and hot caustic solution respectively pass through pipes 9 and 10 to a closed circuit reactor (11) containing a centrifugal pump (12) as a combined means of circulation and dispersing. A heat exchanger (13) is provided to absorb the heat of reaction.

The closed circuit reactor discharges through a stop valve (14), heat exchanger (15) and pressure reducing valve (16). All moving parts of the apparatus are "traced" with small-bore steam tubing to supply additional heat thereto and thus prevent solidification of rosin and rosin size therein. In preferred operation rosin is melted under a blanket of inert gas in a tank (1) and sodium hydroxide solution of suitable strength is pumped into another tank (5). The two materials are pumped through the proportioning pump (4) and are separately fed into the closed circuit reactor at a suitable temperature and pressure in size-making ratio, the caustic being heated (generally to a temperature somewhat below that of the rosin) in the heat exchanger (7).



Schematic of liquid rosin size manufacturing process.

Protein-Containing Adhesive

U.S. Patent 2,844,482, issued July 22, 1958 to Donald F. Maskey, and assigned to Buckeye Cellulose Corp., discloses a vegetable protein-containing adhesive composition suitable for solid fiber laminating which is capable of developing a water-resistant bond.

The adhesive consists of 10 to 16% of a substantially unhydrolyzed, chemically isolated soybean protein and, by weight of the protein, 140 to 280% of a kaolinite clay, 8 to 11.5% sodium sulfite and 1.7 to 2.2% glyoxal. The water content is such that the total solids content is 37 to 44%. The adhesive has a pot life of at least 72 hours.

Thick-Pasting Starch

U.S. 2,838,465, issued June 10, 1958 to Thaddeus Porowski, assigned to A. E. Staley Mfg. Co., describes a process for preparing a starch product characterized by its ability to form high viscosity starch pastes which are stable at high temperatures.

An aqueous slurry of starch is reacted, at an acid pH and a temperature of at least 70°F. (but substantially below the pasting temperature of the starch), with 0.05 to 0.15% of a water-soluble heat-reactive ureaformaldehyde composition based on the weight of starch in the slurry. The pH of the reacted medium is adjusted to an alkaline pH up to ten, and the starch-resin reaction product is recovered from the alkaline medium.

Dextrinization Process

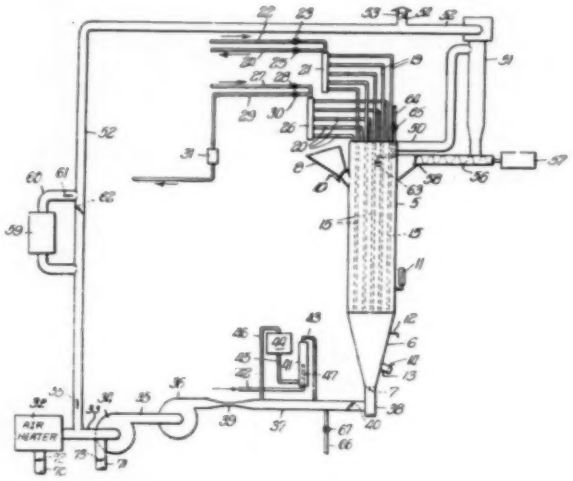
U.S. Patent 2,845,368, issued July 29, 1958 to Ralph E. C. Fredrickson, assigned to A. E. Staley Mfg. Co., relates to the production of dextrins from starch when it is in a fluidized condition.

The conventional batch dextrinization process is inherently very slow and inefficient. If the starch is heated too rapidly, the moisture envolved condenses on the starch and the entire batch will be quickly transformed into a hard glassy mass which has to be removed from the dextrin cooker by digging and chiseling. Hence, the practice is to heat each batch of starch very slowly until its temperature is gradually raised to a point where the starch is dry and converted to a dextrin.

Even after the dextrinization is complete, considerable cooling times are required because of the limited cooling surfaces and low heat transfer coefficients of the equipment used. The conventional batch process takes from 3 to 24 hours depending primarly upon the type of dextrin prepared.

It was determined by means of suitable experiments that the dextrinization reaction itself is not inherently a slow reaction, but on the contrary, is a surprisingly rapid one. Thus, when properly acidified dry starch powder was spread in a thin layer on a preheated metal plate and immediately covered with a similarly heated plate, it was found that substantial conversion, i.e., dextrinization, occurred in as little as 30 seconds. Therefore, it was evident from these experiments that it was at

least theoretically possible to produce dextrins in a very short period of time if suitable means could be provided whereby the temperature of the starch could be quickly raised to the desired dextrinizing temperatures and then quickly cooled after dextrinization.



Schematic of production of dextrins from starch.

In the diagram, a vessel (5) is first loaded or charged with up to a ton of powdered starch of commercial moisture content, e.g., 10 to 13%. Blowers (34 and 36) are started and a control valve (40) is adjusted to give an air flow which will fluidize the starch in the vessel. When desirable, air or other fluidizing gas may be initially heated to the desired temperature by drawing it through a heater (32). Preheating the air in the initial stages avoids condensation on the upper walls of the fluidizing vessel (5) and in the ducts during the early stages.

In order to obtain the proper type of fluidization, the air flow must be such that it will insure fluidization of the entire contents of the vessel with no large dead spots or non-fluidized areas. At low flow rates of the fluidizing gas, only the center core of the bed of starch is fluidized. As the flow rate increases the zone of fluidization expands until the entire bed becomes fluidized.

The upper limits of the flow rate of the fluidizing air or gas is determined by the velocity at which the contents of the vessel tend to be conveyed out or blown out. This is referred to as the conveying velocity. Generally, it is preferred to operate below the upper limits since the power costs increase sharply with increased flow rates. Futhermore, as the flow rate increases there is an increase in dust entrainment.

Even though fluidized beds are notable for a high degree of temperature uniformity, the uniformity is not perfect. Therefore, the dew point of the air within the fluidized bed must be maintained above the temperature of the coldest starch in it. Otherwise, if the flow rate of the air or other fluidizing gas is too low for the rate of heat input (or rate of evaporation of moisture from the starch), the dew point of the air may fall low enough so that the moisture condenses on the cool starch localities and forms balls of starch.

After the blowers (34 and 36) have been started, steam is introduced into coils (15) in the vessel by opening valves (23 and 30) in steam supply lines (22 and 29). Steam pressures of about 150 psig (pounds per square inch gauge) are suitable. After the temperature of the starch reaches about 225°F., a hydrochloric acid vaporizer (41) is placed in operation so as to vaporize the acid into the air stream. For example, sufficient 30% acid may be volitilized so that sufficient HCl is evaporated to equal 0.1% of the weight of the starch. The conditions within the vessel (5) are followed as the conversion proceeds and samples are removed from time to time for checking purposes. When the proper degree of conversion or dextrinization has been obtained, depending upon the particular dextrin product being produced, the reaction may be guickly arrested by introducing ammonia into the fluidizing gas so as to neutralize the starch.

Thereafter, the steam is shut off and cooling water is introduced into the coils (15). After the starch has been cooled to the proper temperature, e. g., 150 to 170°F., the flow of fluidizing air or other gas is reduced from 200 cfm (cubic feet per minute) to form 20 to 50 cfm and the dextrin is discharged into bags or containers through a spout (13).

Other Patents of Interest

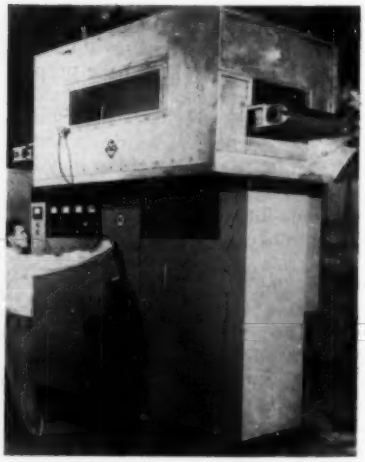
Subject	Inventor or Assignee	Patent No.	Date
Chloroprene cement	Freeman Chemical Corp.	2,838,463	6/10/58
Apparatus for dispensing and severing uniform lengths of adhesive coated tape	Western Electric Co., Inc.	2,839,023	6/17/58
Machine for dispensing tape	H. F. Hanscom & Co., Inc	2,839,137	6/17/58
Tape dispensers	Clarence W. Vogt	2,839,139-40	6/17/58
Applicator for annular gummed reinforcements	Eugene Forshey	2,839,212	6/17/58
Aryl phosphate plasticizer alkyd resin adhesive compositions	American Optical Co.	2,840,535	6/24/58

Copies of any patents, including those described here, are available from the Commissioner of Patents, Washington 25, D. C., for 25 cents each. Do not send stamps.

new equipment

Dielectric Heater

To conserve floor space, a new 15-kw dielectric heater has its oven mounted on the top. Designed for handling various types of unit chemical products in connection with laboratory research work, the heater is mounted on rollers for ease in moving. A removable front makes for easy accessibility and permits use of an endless type belt. The unit shown occupies 4½ by 8 feet of floor space and has an over-all height of 10⅙ feet. The heater illustrated is designed for use in drying operations, though other models are being successfully applied in speedy heating, baking and curing of non-conductive materials. *Allis-Chalmers Manufacturing Co.* E-20



Allis-Chalmers Dielectric Heater

Ultrasonic Homogenizers

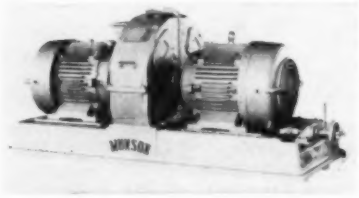
Ultrasonic emulsifiers, which use the fluid-dynamic forces of the liquids themselves to produce the sound waves, come in four models: Minisonic, for small batch or pilot plant use; Rapisonic, a general purpose production homogenizer; Autosonic, for a continuous supply automatically geared to demand, and Dispersonic, for dispersions and abrasive emulsions. Advantages claimed by the manufacturer include, among others, the ability to handle all kinds of emulsions; simple design; low cost operation; easy cleaning and maintenance; elimination of pre-mixing; no aeration; and fast emulsification. Recommended uses include preparation of starch adhesives. *Sonic Engineering Corp.* E-21

Weigher and Filler

The Holm Model GF motorless weighing and filling machine weighs free-flowing materials and drops specified amounts into containers. The machine requires no driving mechanism, and consequently is of simple, inexpensive design. It is said to make 18 to 20 accurate weighings per minute. Dimensions are 36 x 16 x 20 inches. *Richardson Scale Co.* E-22

Munson Attrition Mills

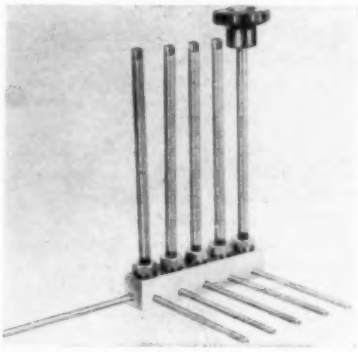
A line of ball bearing attrition mills features machines which grind fine enough so that the product will pass through a 250 mesh screen. The bed of each of the mills is a rigid, one-piece seasoned gray iron casting, which insures the ability to withstand hard and rugged service. The adjusting end slides out for inspection of interior and change of plates. Any adjustment from fine to coarse grinding is made by a polished hand wheel, even while the machine is in motion. The grinding plates, or burrs, are made of a special composition metal which is the toughest the company has discovered for grinding of any friable material. Capacities of the mills vary according to the nature of the stock and fineness of the grinding. *Munson Mill Machinery Co.* E-23



Munson Attrition Mill

Packless Valve Manifold

A new packless valve manifold with minimum holdup is a compact device consisting of five packless valves having .0006 cubic inches volumetric displacement. It can be actuated for programming applications.



Dahl Packless Valve Manifold

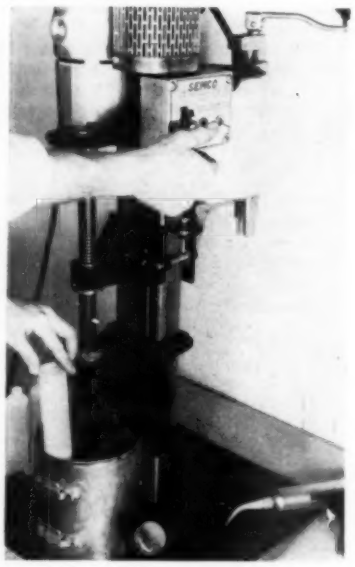
Featured in the design are soldered, welded, tubing or NPT connections with applicable materials of manufacture for high or low temperature use, for high pressure or vacuum service. Minimum holdup is said to reduce contamination of the sample The unit shown is stainless steel throughout with common inlet and individual outlet connections and stainless steel tubing, 1/16-inch I.D., 3/16-inch O.D. Other cam actuated models are available with cam cut to meet the user's needs. *George W. Dahl Co., Inc.* E-24

Two-Part Resin Dispenser

A Triplematic pump for automatic mixing, metering and dispensing of two-part resins dispenses up to 36,000 shots of mixed material per shift. The pump requires only two adjustments: the ratio adjustment, made when the pump is installed and becomes permanent, and the volume control, made to suit each requirement. The pump is manufactured with a limited range of viscosities and ratios for simplicity of design and low first costs. Conversion kits are available for speedy changeover of any model to handle any other range required. The pump is designed to dispense a precisely-measured shot of mixed material, up to 24 ml. from 1 to 72 times per minute at constant speed, regardless of viscosity or volume of the shot. Positive cut-off permits integration into a fully automated operation. *H. V. Hardman Co., Inc.* E-25

Semco Mixing Machine

A new portable electric sealant mixing machine is said to feature ease and simplicity of operation in the preparation of caulking compounds for aircraft, automotive, marine construction and electric sealants. Serving a dual purpose, the



Semco Mixing Machine

machine both mixes sealants and extrudes the mixture into disposable polyethylene cartridges for use with hand or powered sealant guns. Up to one gallon of sealant may be mixed at one time in the standard gallon can in which the sealant material, supplied by the manufacturer of the machine, comes. Other features include a 115-volt electric motor, which may be utilized either manually or automatically, and an attached heavy-duty can opener for crimping the can edge to a smooth surface to facilitate sealing the can air tight during mixing and filling. *Semco Sales and Service, Inc.* E-26

Electronic Counter

The Tally-Count, a new predetermining electronic counter, is said to automatically control any industrial process involving high-speed counting. The instrument is designed to control batching, machine cycling, sorting, materials handling, packaging and unit flows at speeds higher than 100 a second. Individual plug-in decades simplify maintenance, and permit the user to expand the Tally-Count from a 2-decade to a 3- or 4-decade counter with no wiring change. The power supply is also a plug-in unit. The device may be actuated by relay, photoelectric control, microswitch or toggle switch. *Standard Instrument Corp.* E-27

Atomizing Nozzles

A line of atomizing nozzles features nozzles for spraying liquids in quantities up to about three gpm. They produce fine, uniformly atomized, hollow-cone sprays, according to the manufacturer. Nozzles are available in several sizes to produce sprays in a wide range of capacities depending upon the size of orifice opening and liquid supply pressure. At 150 psig, for instance, the nozzles provide capacities from 250 gallons per hour down to 15 gallons per hour. With 50 psig supply pressure these nozzles deliver from 145 down to 8.5 gallons per hour. *Schutte and Koerting Co.* E-28

Storage Racks

Low-cost storage racks, designated by the manufacturer as Series P-S 58, are applicable in the warehousing of almost any kind of material. The racks are of extremely simple construction, and are designed to be erected or dismantled by hand. There are only two parts: the vertical panels and the shelves which snap into panel slots to give rigid support. No bolting or welding is necessary. The racks are built to customer specifications of heavy duty channel steel for use with pallets, skids or barrels for storage of light or heavy materials up to ceiling height. *Palmer-Shile Co.* E-29

Hanna Hydraulic Cylinders

New high pressure hydraulic cylinders, called the Powrdraulic Series, are rated at 200 psi and 3000 psi non-shock hydraulic pressures and have a high safety factor. These cylinders have industry standard mounting dimensions and conform to J.I.C. recommendations. There are 13 basic mounting styles available and a choice of rod sizes for each bore, which means that a standard cylinder can be provided for practically every cylinder application. A special method for sealing the head to the tube is said to insure that tube seals remain tight at all pressures. *Hanna Engineering Works.* E-30

Walkie Truck

High stacking of loads in minimum aisle space is facilitated by an extremely compact, counterbalanced-type "walkie" truck. Called the JackStacker, this truck has a 1000-pound capacity, and an over-all length of 63¾ inches with a 24-inch long load. It will maneuver and high stack goods in aisles as little as 70 inches wide with a 24-inch long load, an extremely narrow space for a counterbalanced-type truck. *Lewis-Shepard Products, Inc.* E-31

Rubber-Fabric Container

A new molded, reinforced rubber-fabric container, named the Fortex Gar-Boy, is claimed to be resistant to lime, acids, grease, chemicals and other materials. The container, which holds ten gallons of most liquids,

Fortex Gar-Boy Container

waste or other substances, is designed to be easily cleaned and odor-proofed. The over-all dimesions are 16½-inches top diameter, and 19-inches height. Said to be practically indestructable, with no seams to split and no metal parts to rust, it is unaffected by extremes of heat and cold. *Cauchotex Industries.* E-32

FOR MORE INFORMATION on the new equipment items described here, use the Reader's Service Card elsewhere in this issue.

Epoxy Resins. By Dr. Irving Skeist. Published by Reinhold Publishing Corp., 430 Park Avenue, New York 22, N. Y. 5¼ x 7½ in. 292 pp. $5.50.

In recent years a group of resins has grown from a laboratory curiosity to a flourishing industry. The epoxies particularly have constituted a surprise in themselves.

So fast, complicated and involuted has this growth and success been, that epoxies are in themselves most confusing. Their formulations, their trade names, the methods of manufacture and the tremendously variegated applications to which they are put constitute a most intricate and hard-to-comprehend field to the uninitiate. In fact, many a well-informed chemist has come up with moments of intense stupefaction where epoxy resins have been concerned.

Dr. Skeist's book tends to rip away many of the cobwebs from this maddening set of compounds. It constitutes a powerful little member of Reinhold's "Plastics Application Series." These books are not designed to appeal particularly to the reader who has extensive chemical training. Still, engineers, chemists, purchasing agents and many small businessmen in a large variety of fields will gain immeasurably from this volume.

Taken all in all, this book is perhaps the best one yet written on epoxy resins. Despite the non-technical nature of the text and the attempts of the author to make each chapter self-contained, there is little repetition and a clarity of presentation which is welcome. George R. Somerville, Supervisor of Surface Coating Resin Dept. of Shell Chemical Corp., has written the Chapter on "Properties and Applications of Epoxy Resins in Surface Coatings." This is perhaps one of the finest such coverages ever written on the subject.

There is one place which must be mentioned in any review. Dr. Skeist's Chapter 2, "The Resin Intermediates" presents the story of cross-linking and functionality better than it has ever been presented anywhere. This is the real value of this book: Anyone will profit by its reading.

The role of epoxies in adhesives, however, is unfortunately not exhaustively covered. The one chapter devoted to it also attempts to cover patching and caulking. This tends to make the chapter on adhesives somewhat weak. Despite the cry that the percentage of epoxies used in this field is "small," that the monetary return from adhesives is not as large as the other applications, as editors of an adhesives magazine we feel this more markedly. However, we cannot really impugn the book on this account. It is just that a whole new world of adhesive use and application has been opened with epoxies. New methods and possibilities have only just begun to be suggested and achieved because we have epoxies—and this particular part of the subject is treated "glissando" and curtly here. Still, we really shouldn't expect much more in a book which is primarily devoted to the whole field of epoxy resins. First and foremost they are plastics.

While it is true that many epoxy formulations have as many as seventeen and twenty ingredients, every formulation carried in this book is basic and functional. Not one formulation given here is experimental, suggested, or over-specialized. These are genuine and applicable as they are given. Hats off.

Polyamide Resins. By Don E. Floyd. Published by Reinhold Publishing Corp., 430 Park Avenue, New York 22, N. Y. 5¼ x 7¾ in. 230 pp. $4.50.

This volume, authored by the head of the Chemical Applications Section of General Mills, deals with the basic chemistry and raw materials of polyamide resins and with methods of their manufacture. An excellent discussion of key properties is included, and information provided on all important applications of the resins. Predictions of future trends supplement the over-all survey of the field at present.

One chapter is devoted entirely to adhesives. Discussed are hot-melt adhesives, solution type adhesives, polyamides for adhesives, applications, thermosetting adhesives, epoxy alloys, variables in thermoset adhesives, uses of thermoset adhesives and phenolic-resin alloys. In the analysis of commercial applications, formulas are provided for a metal-to-metal adhesive; a general purpose low temperature adhesive; a flexible adhesive; a delayed-tack adhesive; a polyethylene adhesive; a glassine and general purpose paper adhesive; block-resistant adhesives; and a hot-melt low temperature adhesive. Also given are six recipes for bookbinding adhesives, as well as others to meet specific requirements.

Extensive data on results of tests of various properties of the formulations (impact, peel strength, effects of solvents and chemicals, environmental conditions, hardness, etc.) are presented in tabular form. A list of eight literature references closes the chapter on adhesives.

This volume is one of a series being published on the various materials of the plastics industry, and their applications. Semi-technical in character, so that one does not have to be a chemist to grasp the material, the series is a valuable addition to the literature to those engaged in the many facets of the plastic industry which are directly or indirectly related to the technical and research sides.

This particular volume is well written, comprehensive and clear. The illustrations and graphs are wisely chosen to supplement the text in telling the story of polyamide resins in industry.

How to Plan Products That Sell. (Management Report No. 13). Published by American Management Association, Inc., 1515 Broadway, New York 36, New York. 6 x 9 in. 148 pp. $2.50 (members); $3.75 (non-members).

This report has been designed to provide alert managements with an opportunity to compare elements of their own new-product programs with those of some of today's most successful innovators, from basic policy planning to marketing and distribution. The papers of which it is comprised were originally presented at a conference sponsored by the American Management Association which was held recently for this purpose. The authors were recruited from some of the nation's outstanding industrial organizations.

The book is divided into three sections: "Planning for Products," "Planning for Sales" and "Three Case Studies." In the first the papers analyze such topics as a management philosophy for creating new products through research, the role of engineering in product development, staffing the new product development program, using outside research facilities and new chemical products and health hazards.

In the second part the authors discuss techniques of market measurement and other subjects. A team of representatives from Batten, Barton, Durstine & Osborne, New York advertising agency, analyzes the techniques involved in planning for sales, illustrating their theses with case histories of successful commercial products.

The last section also presents case studies of new commercial products which were well received. Such considerations as analyzing the need for a new product and engineering and marketing aspects of the launching venture are described.

In this day when the costs involved in developing new products are high, and at the same time a strongly competitive market makes new products a necessity, the comments of the various authors have real meaning. They discuss a complex and unfortunately nebulous facet of commercial operation, but a vital one. Much of what they say can well be read and digested.

Trade Literature

Continuous Reactor. A processing machine which is essentially a continuous reactor combining continuous mixing with accurate process temperature control is described in a 4-page bulletin. Analyzed are such factors as construction; sizes and capacities available; ease of cleaning; materials of construction, and other engineering features. Typical applicable heat transfer calculations are made, and laboratory and testing facilities of the manufacturer are described. The last page is devoted to commercial applications. *Baker Perkins, Inc.* L-22

Insulation Adhesive. A material which is a two-component low temperature asphaltic adhesive, moisture seal and vapor seal is described in a 4-page brochure. Designated Insulgrip, the product is used for application of rigid low temperature insulation such as cork, rock cork, expanded and foamed polystyrene and similar lightweight insulation media. Physical characteristics (shrinkage, moisture resistance, adhesive strength, bonding time, etc.) are detailed. Application directions are included. The last page of the bulletin is devoted to Insulplaster, a plaster material which also protects against moisture penetration. *Borden Chemical Co.* L-23

Hospital Labels. A 16-page general catalog illustrates and describes a complete line of time tape and labels for hospital and laboratory use. Adhesive and vinyl coated, these products come with any of over 3000 printed legends or unprinted. Time labels indicate that an object is sterilized, the word "sterile" appearing on the label after it has been subjected to a predetermined temperature for a specific amount of time. *Professional Tape Co., Inc.* L-24

Epon Resins. A small booklet is devoted to commercial applications of Epon resins. These include a metal-to-metal adhesive for construction of airplane wings and use in an adhesive for sealing the joints of clay pipe. Attractively designed and printed in two colors, the booklet contains complete descriptions of the various commercial uses, with data on costs, physical properties and other subjects. Photographs of the finished products enhance the presentation. *Shell Chemical Corp* L-25

Industrial Sterilization. A 12-page booklet has been prepared for the increasingly large number of industrial firms that include sterilization as an integral part of their product processing. The bulletin describes an engineering-sterilization service designed to assist manufacturers in choosing the best sterilizing medium for their products. Vitrues and limitations of the steam and dry heat methods are discussed, and a special section is devoted to newly developed automatic gas sterilization. *Wilmot Castle Co.* L-26

Adhesive Products. Ray-Bond adhesives, protective coatings and sealers, as well as casting, encapsulating and potting compounds, are described at length in a new 16-page bulletin. Sections deal with the selection of adhesives for fulfilling specified functions under various service conditions; the bonding technique, described in detail in five pages; and typical adhesive applications. Included in the booklet is a loose sheet on which characteristics of principal Ray-Bond adhesives are presented in tabular form; type, characteristics, solvent, uses and bonding requirements are considered. *Raybestos-Manhattan, Inc.* L-27

Railroad Industry Adhesives. A new 8-page catalog describes adhesives, coatings and sealers for the railroad industry. Twenty-three typical applications of eleven different types of these products as used on a typical piece of rolling stock are listed. Two pages are devoted to photos showing application methods for various materials to prevent corrosion; seal out water, air and dirt; mount floor coverings and adhere insulation and resist abrasion. *Minnesota Mining and Manufacturing Co.* L-28

Industrial Coatings. Coatings for use on metal, plastics, glass and wood are described in a 36-page brochure. Information on numerous coatings for application to the various surfaces by spraying, screening and roller coating is provided. In addition to clear coatings, coatings in standard colors, including metallics, bronzeless gold and other special effects, are available. Extensive data are given on preparation, characteristics of the coatings, application techniques and physical properties. Loss of adhesion, perhaps the most common and recurrent application problem, is discussed at length. *Bee Chemical Co.* L-29

FOR MORE INFORMATION on the trade literature reviewed here, use the Reader's Service Card elsewhere in this issue.

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From Here and There

Metric Measure Argument

In Britain, there is an acute awareness of the need to standardize its measurements with the metric system. The British seem to feel that it is no mistake that the first earth satellite was launched by the Soviet Union . . . a nation using the metric scale. Dr. A. H. Hughes of the British Association for the Advancement of Science, has pointed out that not only is the British system archaic, but that its system and that of the United States are only approximately similar.

Dr. Hughes gives examples, such as: The British yard is only .999997 as long as the United States yard; The British bushel equals 36.37 metric liters and the United States bushel is only 35.2383 liters; And the British gallon equals 4.5459631 liters, while the United States gallon is 3.785332 liters.

There are many other such inconsistencies in the British-American system. To make matters worse, we have scientists who design apparatus in centimeters, and then turn the specifications over to engineers, who have been brought up on fractions and inches.

We cannot but agree with the British and argue strongly in favor of standardization among all nations. The adhesives industry would have much to gain by adopting the metric system. Comments from our readers would be welcome.

Construction

Construction is one of the largest fields for the application of adhesives, we believe. We have heard many speeches, talks and presentations which dealt with adhesives in building and construction. This is, perhaps, a logical field for the application of adhesives, because construction costs have been soaring. The need for new buildings continues to grow and all sorts of conceivable new techniques are now being applied in an attempt to speed construction and to lower its cost.

In 1957, one hundred large concerns spent $1,800,000,000 on construction, with the American Telephone and Telegraph Co. at the top of the list. This company made an expenditure of $215,000,000 . . . Ford Motor Co. spent $127,300,000 . . . Western Electric made an outlay of $65,900,000. Nine of the top construction clients in 1957 were industrial corporations. Twenty-one of the top twenty-five companies were also industrial concerns and, of the one hundred leading companies, seventy-five were in the industrial category. These firms accounted for $1,300,000,000 of the money spent for building purposes.

Meanwhile, the costs of building have risen 152 per cent since 1941. The building dollar now buys 40¢ worth, which means that the buyer must put down $2.52 to buy what a dollar bought before the war. It appears that this ratio can be expected to increase in the next twelve months to $2.65. The increase will apply to office buildings, schools and other non-residential structures.

Of the two major components of construction costs—materials and labor—the price of labor shows the largest increase. Assembly line prefabrication with the use of adhesives and sealants is strongly indicated as a means of effecting great savings in both materials and labor. Then, in approaching the building site, many ingenious and effective techniques can be used to speed construction itself, to further hold down costs.

About Epoxy Resins

During October, Mr. Ed Big, technical sales manager of the Epoxylite Corp., relayed to Dr. Irving Skeist the compliments of Dr. Henry Lee and Kris Neville, who wrote the first book in this country on epoxy resins. Dr. Skeist's book. "Epoxy Resins" which was published in September, is reviewed in this issue.

Frequently, in industrial usage, we have seen epoxy poured from paper cups. Pouring from these cups is not the best way to handle epoxy resins. The depth causes the heat to be entrapped and reduces the pot life of the adhesive. A shallow aluminum pan or tin plate are far better for this purpose. We are sure that use of the containers would at least *double* pot life.

How Come?

In recent months, there has been a tendency on the part of friends, relatives and acquaintances to refer gripes and growls about adhesives to us. It's amazing how many little matters that we don't think about irritate the gals—to the detriment of the whole industry. The complaints run something like this:

"So they can paste airplanes together, but the metallic Christmas seals offered, pop right off within a few minutes. And they ain't cheap, either."

"You know, I think somebody who is clever could make a mint if he invented a label that would positively stick to leatherette. You should see how much trouble we have in our office getting labels to stay on notebooks. I'll bet the order from the government alone would keep somebody in business."

"Why don't the stores have gummed tape which sticks to boxes: The clerks put a handle, attached with tape, on the large boxes. By the time you get home, the tape is off and the box is in your arms."